THE

# ELECTRICAL REVIEW.

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## ELECTRICAL REVIEW.

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THE

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## THE STANDARD TROLLEY WHEEL GROOVE.

THE Electric Tramways Sub-committee of the Engineering Standards Committee have just published their recommendations with regard to the section of the groove of trolley wheels. The preface occupies one page and the recommendation another, when well spread out, and the whole is sold at 1s. For ourselves, we are inclined to think that the groove section illustrated in the report (width at rims $1\frac{3}{8}$ in., depth $\frac{3}{4}$ in., radius $\frac{7}{32}$ in., angle 65°), will not meet with approval wherever the wire is circular, but it would seem to be satisfactory with an 8 section where the running surface is not broken by ears, and there is no doubt that in 10 years' time any overhead systems that still exist will have the trolley wire shaped or suspended in such a way that absolutely smooth running is obtained for the trolley wheel.

"The Sub-Committee are engaged upon the several questions involved in the standardisation of electrical tramway material," but they resolved not to delay the publication of the groove standard until all the other questions were settled. They "have come to the conclusion that no attempt should be made to standardise any particular design or shape of trolley-wheel."

That is a conclusion which we lament. We expressed a wish lately that the present villainously long list of trolley-wheels, all differing in some detail wholly unimportant in itself, but sufficient to prevent interchangeability of parts, and to necessitate a correspondingly long list of patterns, should be standardised out of existence.

Where is there a tramway engineer who has not designed and generally patented or registered a trolley head? And, as most of these designs have been made without much relation to others, it follows that even when some totally new ball-bearing arrangement or lubricating device did not occur to these engineers, the critical dimensions of the trolley wheels varied as much as the heads.

It seems to us that the sub-committee have standardised just the very thing in which some amount of flexibility might have been allowed, while they have left undone the several things which they might have done.

Naturally, they have to be careful to avoid stultifying themselves by standardising without cause clearly shown, but in the case of the trolley wheel a very clear case can be brought in favour of standardising the design of the whole, not merely of one portion.

At present it is doubtful whether any considerable advantage is to be gained by using trolley wheels which are larger in diameter than the average wheel now in use, nor until the speeds generally allowed exceed 15 miles per hour, is it probable that larger diameters will be worth considering. In any case the number of lines on which speeds less than 15 miles per hour have to be run will be in the majority for years to come, and a standard wheel might well have been drawn out. Practically there are but two con-

ditions which a trolley wheel has to fulfil; it must run equally well on centre and side-running track, that is to say, it must be capable of equally meritorious performance in rigid and swivel heads. Now, the one factor above all others, which determines this, is the section of the groove, and this the Committee have settled—whether for good or evil remains to be proved—at any rate, they have settled it with evidence before them, and they might as well have settled also the dimensions which make no difference in the wire keeping or current collecting capacities of a trolley wheel, but make all the difference between standardisation and confusion. The overall diameter, the diameter at the bottom of the groove, the width of the boss, the diameter of the spindle, are the variables for which no adequate *user's* reason for variation exists. That fixation of these dimensions might affect the makers of certain special designs we admit, but the injury would be temporary only, and we surmise that standardisation in the interests of the general body of users must always affect a few isolated individuals more or less.

That trolley heads should be passed through the standard die is hardly practicable in the present state of affairs, although it is a highly desirable consummation. That applies only to swivel heads on which there are so many patents on details mostly involving bodies of divergent shapes, and it would not do for the Committee to recommend the adoption of a head which combined in itself the best of the really essential devices; but in the matter of rigid heads the same obstacles to a fixed design do not occur, and it is to be regretted that the opportunity for making it has been allowed to slip. Doubtless, the need is not so urgent as in the more difficult case of the swivel head, but there are quite a number of different patterns in use, and some of the most widely used are waiting for some one to come along and design them properly.

As all trolley-wheels have to be run on hard-drawn copper of almost identical analysis, it is not easy to imagine the reasons of the Committee for not including a standard mixture for trolley-wheels in their report. By far too little attention is given to this point, considering the harm that may be done by wheels which are too hard, and it comes within the scope of the Committee's reference as much as the analysis of rails.

It goes against the grain to criticise the labours of an altruist body such as the Sub-Committee on Electric Tramways, but we are in duty bound to express disapproval.

This report contains also a recommendation that the minimum tensile breaking strength for trolley wire up to 00 S.W.G. shall be 24, and above 22 tons per sq. in., and "it has not been deemed advisable to go further in the direction of standardisation" than this.

In view of the present state of transition in trolley wire practice this decision to leave the whole question of sections open for the present is commendable.

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**Gold from a Gilded Ocean.**

In the course of his Presidential Address to the "B" Section of the British Association, Mr. G. T. Beilby gave some interesting figures which, in the present state of our knowledge, show the futility of the proposals made for the recovery of gold from sea water. According to Prof. Liversidge, sea water contains on an average 1 grain of gold per ton; and, therefore, if they are uniformly distributed, each cubic millimetre of the liquid (a quantity roughly equal to the cubical contents of a common pin's head) contains about 4,333,000 molecules of the precious metal, the distance between them being about 600 micro-millimetres, or 1/90,000 of an inch. The point of a very fine sewing needle would cover about 1,000 of the gold molecules, and every drop out of the sea holds many million. This seems sufficiently hopeful to tempt the least sanguine capitalist. But it happens on our existing gold fields that the cyanide liquor which contains 100 grains or more of gold per ton, and the slimes which contain only 18 grains or so when run through the zinc precipitating boxes, issue from those boxes still containing 1·5 grain per ton; and the extraction is not more complete because the chemist cannot make it so, or because a more exhaustive treatment than that which leaves 2 or 3 grains per ton behind would not pay. Thus we have the gold seeker intentionally throwing away from his plant as of no further value, although it has already paid its own costs of collection, preparation, and passage over the zinc, a liquor which is appreciably richer in gold than the ocean it is proposed to treat. The sea contains only half the metal present in the final effluent of the gold works, and yet it would have to be impounded, and handled in a manner that must prove more expensive in labour and material than the simple process of zinc-box precipitation. Our ships may float on a gilded ocean, but in the present state of molecular chemistry—that is a very different matter from the flotation of a company offering gilt-edged securities to the investor.

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**How Not to Invite Tenders.**

There is an old saying "It is possible to overdo a good thing." This was forcibly brought to our mind a few days ago on examining a specification which had been issued inviting tenders for wiring a technical institute in the North of England. There were about 250 lamps, including a few arcs, and the total value of the work on a liberal estimate would not exceed £400. A schedule of lights, a total price, and the sum per lamp, or point at which additions or reductions within certain limits could be made, would have been reasonable, and in many quarters would have been sufficient.

In this case about one hundred separate prices were asked for in a schedule, and the specification was bound in a book containing 27 pages, 14 of which were closely printed general conditions. Many of these were inapplicable to the work in hand, such, for instance, as those relating to the use of crane in generating station, foundations, &c.

Another of these clauses required the tenderer, when sending in his offer, to give two names of gentlemen willing to act as sureties to the extent of 10 per cent. of the contract sum, say, £35 or £40.

This method of obtaining offers for work would be ridiculous were it not unfair alike to contractor and purchaser. It is unjust to the contractor, as it imposes an amount of work upon would-be tenderers quite out of proportion to the value of the contract, and it is unfair to the purchaser, for in the end he has to pay a higher price for the work he actually has done, first, in the cost of printing the specification, and secondly, contractors must charge a higher price for their work to cover the unnecessary work and risks connected with it. It should be remembered that in preparing specifications common sense is as important a factor as technical ability.

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**Tramway Traffic and Accidents in Berlin.**

According to a pamphlet prepared by Herr Bork, of the Imperial Railway Administration at Berlin, the capacity of the power stations which furnish electrical energy for the working of the tramways in Berlin amounts to 70,000 H.P., of which 30,000 H.P. is required during the period of largest demand. The length of track in operation exceeds 434 miles, and the number o

cars in service is about 2,700, of which 1,600 are motor-cars. The number of passengers carried, apparently in 1904, was as follows by the methods of locomotion mentioned :—

| | No. of passengers. |
|---|---|
| Electric tramways... ... ... | 395,000,000 |
| City railway ... ... ... | 110,000,000 |
| Omnibuses ... ... ... ... | 94,000,000 |
| Elevated electric railway... ... | 33,000,000 |

The passenger traffic on the tramways has increased in the past decade from 157 millions to 390 millions. As to the question of accidents, it appears that these largely increased during the period of transition from horse to electric traction. Ten years ago the number of persons severely injured, or who received fatal injuries, averaged ·48 per million passengers, whereas in 1900 the figure advanced to 1·18 per million, the increase being specially the case owing to persons jumping on, or alighting from, cars in motion, being run over, or in consequence of collisions. In 1904, however, a considerable decrease took place in the number of accidents which are now not any more numerous than in the former days of horse cars. The persons severely or fatally injured in the past five years have receded from 1·18 to ·53 per million passengers, and these also are not in excess of those obtaining in the old horse days, notwithstanding the considerable augmentation in the traffic. On the question of collisions, Herr Bork shows that these are mostly caused by contact between cars and other vehicles, but the number has been largely reduced by the compulsory adoption of brakes on wagons and other vehicles which carry heavy loads. The interruptions in the working of the tramways are principally caused by the mixed system of trolley and conduit cars, and the removal of the latter class is said to be desirable in the interest of the service.

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**The Transvaal Technical Institute.**

The first annual report of the work done by the Transvaal Technical Institute has recently been issued. This institution was founded in the years 1903-4 in consequence of a report drawn up by a representative commission which had been appointed to consider how the needs of the colony in the matter of technical instruction could best be met. Lord Milner nominated a council of 11 members (now increased to 25) to act as governing body, and the services of Prof. Hele-Shaw, of Liverpool University, were secured, to act as Principal and Organiser. Lectures and classes in mathematics, chemistry, physics, geology, and electro-technics were arranged for ; and the regulations for admitting students were drafted in a somewhat elastic fashion, so that any youth over 16 years of age who can satisfy the Board of Studies that he is capable of benefiting by the instruction afforded, and to whose admission the council does not take exception, may enter. This allows every single case where such difficulties as the colour-question arise, to be decided upon its own merits. Diploma courses may be taken without previous matriculation, but the actual diploma is not awarded unless the student has matriculated, or does so afterwards.

Work began in March, 1904, with 42 students. There are now 54 in the engineering classes, and the same number of law students. In the first year only four came from the Transvaal, now there are 21. The staff consists of eight professors and four assistants, beside the Principal. Evening classes are held at an increasing number of centres, 426 students have joined, and the entries are already much higher in number. Evening class certificates secured by apprentices in the railway works at Pretoria carry with them a special increase in wages. When a full teaching University for South Africa comes to be founded, it is hoped that various colleges and institutes, such as the above, situated in the colonies where the University is not placed, may, nevertheless, be regarded as integral parts thereof.

**The International Glow Lamp Syndicate.**

It is stated that this syndicate has succeeded in arriving at an understanding with one of its strongest rivals—namely, the Bergmann Electricity Works Co., of Berlin. The arrangement takes the form of an agreement in regard to prices without the company formally becoming a member of the syndicate. Before the conclusion of the agreement the syndicate was confronted with the prospect of the Bergmann Co. producing lamps on a considerable scale, and with the possibility, it is said, of being undersold, and the existence of the combination being thereby endangered. It was for these reasons that the problem of dissolving the syndicate was taken into consideration a little time ago, but a solution has been found in the manner indicated. The Bergmann Co. has an annual output of lamps of the value of £50,000. It is also reported that the question of combination has now made progress among the smaller makers who do not belong to the syndicate, and a second syndicate is in contemplation so as to represent these outsiders. This further movement is attributed to the pressure exerted by merchants on the small non-combined firms in regard to the conditions relating to the consumption of glow lamps.

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**Claims for the Impossible.**

The average education of the engineer must be rated at a very low level by many patentees and manufacturers, or surely the large number of claims made for impossible or improbable performances would be much reduced. Actual pretenders to perpetual motion are now comparatively scarce, and those who do make what amounts to a claim for this impossibility, do so in ignorance. But in regard to matters involving physical facts the position is even less satisfactory. The great object seems to be to secure a result, or the statement of a result, which will beat all records. Boilers are no different, except in quality of material and workmanship, from what they were 30 years ago ; there is no greater skill in their handling. Yet as 30 years ago efficiencies of 70 per cent. were obtained, it has become necessary, in order to beat the record, to keep adding to the efficiency, until to-day thermal efficiencies, as between coal and steam, of over 88 per cent. are claimed. Thus within the narrow margin of 12 per cent. there must be contained the whole of the heat in the waste gases and the whole of the radiation losses.

It has already been pointed out in our columns that very great caution should be exercised in setting down the thermal efficiency of a boiler. It is not possible to reduce the temperature of the waste gases below that of the steam produced by the boiler. In the very best practice the waste gases will probably be 100° F. hotter than the boiler. Some few years ago an engineer reported a test which showed that the boiler was actually hotter than the waste gases, and he stuck to the claim too. If only the amount of air used per pound of coal be known, it becomes a very simple matter to calculate how much heat really does escape at the chimney, and if many boiler tests be examined, and probable values put to some of the omitted items, the total heat accounted for comes perilously close to 105 per cent. of the heat capacity of the coal.

Then, again, claims are made which are contradictory. The calorific capacity of a coal is quoted firmly. Then its combustible percentage is stated in an equally dogmatic manner. Yet the one inevitably contradicts the other, and the heat capacity of the steam output, plus that of the waste gases, far outruns that of the coal.

To put forward such figures is a clumsy blunder exhibiting a lack of the common A.B.C. of engineering knowledge, and it tends to make those who do know scoff at what appears to them to be no better than fraud. Further, the exaggeration of results may prevent the success of real improvements, because the genuine test is faced with some old exaggerated false record that cannot be upheld, but carries the imprint of some engineers' approval. If men were sound in their technical knowledge, they would surely cease to receive elaborately printed claims for the performance of the impossible.

D

## ERITH ELECTRIC TRAMWAYS.

On Saturday last the Erith Urban District Council inaugurated its electric tramway system. The lines thus set in operation have a route mileage of 4·7 miles and a track mileage of 8·4 miles. There are a further 3·4 miles of track authorised, and of these about one mile will be constructed by the L.C.C., to connect up to its system, thus forming a through route to London. Connection is made with the Bexley tramway system at Northumberland Heath, and the

View along the Bexley Road.

direct communication with London will be obtained through Plumstead and Woolwich.

Our readers will remember that Erith already has a municipal electric light and power supply—the first public three-phase plant in the kingdom—which was started in January, 1903, and was described in the Electrical Review for January 16th of that year. The tramways, of course, take their energy from the same station.

The works buildings have been extended and considerable additional plant has been installed to meet the tramway load, and the power station equipment stands to-day as follows:—

The boiler house contains two 28 ft. × 8 ft. Spurr Inman boilers, rated at 6,000 lb. per hour each and hand fired; also three 28 ft. × 8 ft. 6 in. Yates & Thom boilers rated at 7,500 lb. per hour each, and fitted with Bennis compressed air stokers and Sugden's superheaters capable of superheating the steam to 100° Fahr. above normal temperature. The boilers are fitted with main and auxiliary steam valves, spring loaded and deadweight safety valves of ample area, duplicate feed valves, and injectors capable of maintaining full feed supply. The boilers are fed by two Hall's compound steam pumps of 1,500 and 1,800 gallons per hour respectively, one Pearn's triple-ram pump (driven by a three-phase motor) of 1,500 gallons per hour, and one tail end pump on condenser of 1,500 gallons per hour capacity; all of these deliver through Rankine pressure filters, of which there are two installed. The boilers are covered with Haacke's composition, and set with Poulton's curvilinear blocks and covers.

The station originally contained only one 50-kw. and two 150-kw. steam alternators, all of the International Electrical Engineering Co.'s make, driven by Allen's compound engines. To these have been added two alternators of 500 kw. each, of British Westinghouse make, driven by Belliss triple-expansion engines. All are capable of giving 20 per cent. overload for one hour. The exciters are direct-driven on a continuation of the rotor shaft. The alternators are arranged with revolving fields.

There are two rotary converters of 150 kw. each, and a 75-kw. negative booster, all supplied by the British Westinghouse Co.

The switchboards consist of a H.T. board arranged with front and back panels separated by a 5-ft. gangway; all the H.T. gear is contained on the back framework, and the panels are erected on the cubicle system, with switch-gear and instruments on front panels. All the panels are of white marble.

The original board, which was supplied by the International Electrical Engineering Co., was extended by the General Electric Co., Ltd., and further extended and partly re-arranged by Messrs. Kelvin & Jas. White.

The L.T. board contains tramway feeders, Board of Trade panels, rotary converter, and negative booster panels. The instruments are chiefly of Messrs. Johnson & Phillips, Elliott Bros., and Kelvin & Jas. White's make.

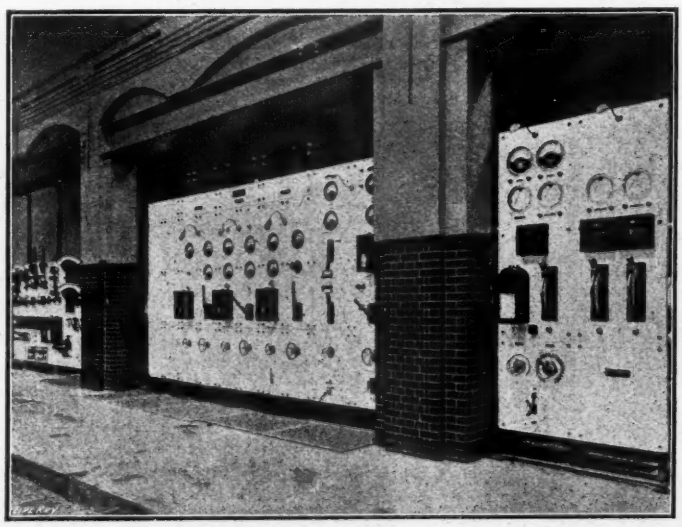
There are two condensers rated at 10,000 lb. per hour each, one by the Wheeler Condenser Co., the other by Blake and Knowles Steam Pump Co. They are of surface type. Circulating water is obtained from a well on the works, and the discharge is made into the River Thames.

A Green's economiser of 192 tubes is installed.

The pipework consists of one main steam range of 7 in. and 8 in. bore, with 6 in. and 4 in. bore branches. The original pipework was done by Messrs. Babcock & Wilcox, Ltd.: this was first extended by the Sir Hiram Maxim Co., and further by Messrs. Babcock & Wilcox.

The track is laid to a 4 ft. 8½ in. gauge, with 60 ft. rails, weighing 100 lb. to the yard. The rails and fish-plates were made by Messrs. Bolckow, Vaughan & Co., and supplied through Messrs. R. W. Blackwell & Co., Ltd., who were the contractors for the permanent way work. Cooper & Howard-Smith's Anchor joints are used at the rail joints and midway in the length of the rail. For the bonding Crown solid 4/0 S.W.G. bonds are used, with cross bonds at every 40 yards. The points and crossings and special work were supplied by Messrs. Hadfield's Steel Foundry Co., Ltd., of their manganese steel. The steepest gradient is 1 in 20, the worst sections continuing for 200 and 320 yards respectively. The sharpest curves are of 40, 42 and 45 ft. Mr. J. W. B. Carruthers acted as clerk of works for the track and overhead construction.

The overhead equipment was carried out by the Brush



The Switchboards at Erith Station.

Electrical Engineering Co. Bracket arm construction is used with side poles throughout, except at curves and junctions, and along Walnut Tree Road, where span construction is adopted. The poles were supplied by Messrs. Stewart & Lloyd, as sub-contractors to the Brush Company.

The trolley wire is of 3/0 S.W.G. copper, with flexible suspension, and protected with stranded galvanised steel guard wires. Where guard wires are erected every fifth pole is earthed.

The line is, as usual, divided into half-mile sections, the section pillars, which were supplied by Callender's Cable Co.,

being fitted with the necessary controlling switches, telephone plugs and lightning arresters.

The 5½ miles of underground feeders also were supplied by Callender's Cable Co.; they have vulcanised bitumen insulation, and were drawn into conduits laid under the track. Test and telephone cables are carried in the same conduits, save for the last half mile section of each route, where they are carried overhead on the tramway poles.

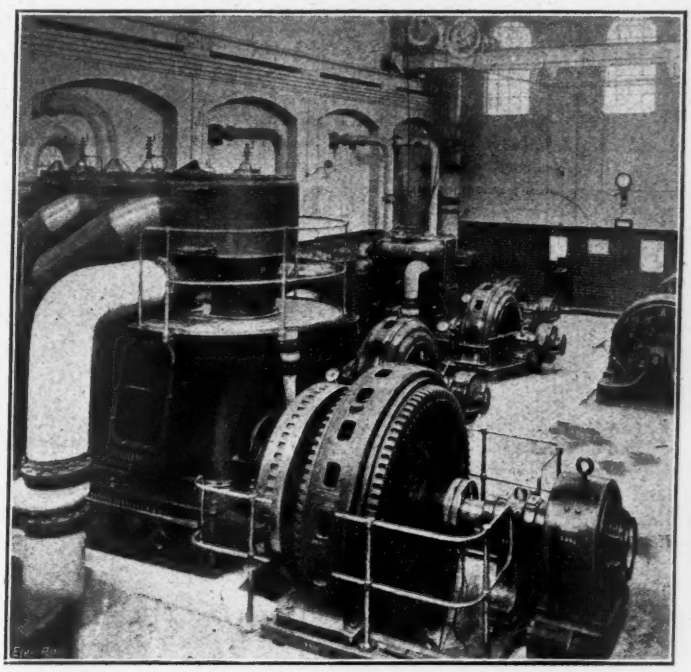
There are at present 14 double-deck cars on four-wheel trucks. The cars and equipments were supplied by the British Westinghouse Co., the bodies by the Brush Co., and the trucks by Messrs. Mountain & Gibson, of Elton Fold Works, Bury. The cars have ordinary hand ratchet and British Westinghouse magnetic track brakes. The trolleys, and also the trigger type lifeguards which are fitted, are by Messrs. Mountain & Gibson, and the trolley heads are of the Woods patent type. Semi-reversed stairways are adopted. There are two British Westinghouse magnetic brake type controllers per car. Seven of the cars have top deck covers, and all are supplied with revolving blind illuminated type destination indicators. The cars are each lighted by means of 17 16-c.p. 100-volt lamps, arranged on three circuits.

A track sweeper and watering car—the work of Messrs. Mountain & Gibson who have made a strong feature of this particular branch for some time—is in service.

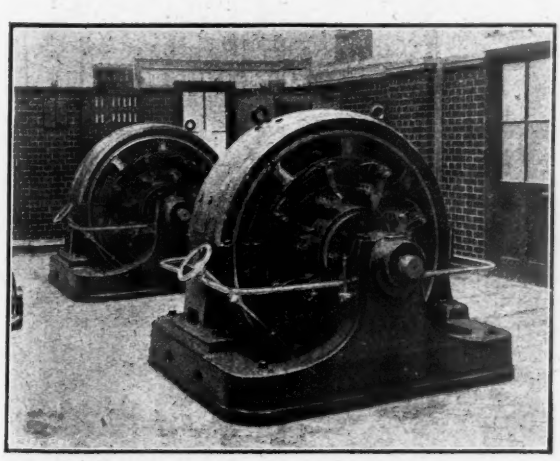
The car-sheds, which have accommodation for 16 cars, stand on the Walnut Tree Estate Station Road, and contiguous to them there are repair shops equipped for light repairs, paint shop, stores and offices.

The Lower Road, which is developing into the main traffic route from Erith to London, crosses the S.E. & C. North Kent Line by a level crossing, and when the tramways were contemplated it became necessary to arrange for a bridged, instead of a level, crossing. The S.E. & C. Railway is throughout this section, approximately, a surface line, and the crossing is also at a very acute angle. To keep the approach gradients as flat as possible it was essential that the depth of bridge deck should be kept very small. The existing double line of railway is crossed by a span of 26 ft. on the square and 40 ft. on skew, two side spans, 14⅛ in. on square and 22 ft. 3 in. on skew, being formed to allow of a future doubling of the railway. The bridge is designed to carry ordinary road traffic and a trolley of 32 tons weight on a 12 ft. × 6 ft. wheel base. The gradients of approaches were kept to 1 in 24·8 on the west side and 1 in 30 on the east. The contract for this bridge was placed last summer in the hands of Messrs. W. Pattinson & Sons, Ltd., of Westminster, who carried out the whole of the work without, in any way, interfering with the traffic on the S.E. & C. Railway.

Messrs. Hawtayne & Zeden, of London, who were responsible for the original electric lighting and power installation and extensions thereto, have also acted as consulting engineers for the equipment of the Erith Tramways, and the steel deck bridge which carries them across the North Kent line of the S.E. and C. Railway, and to them we are indebted for assistance in preparing this description.



Erith Generating Station. View showing one of the Belliss-British Westinghouse 500-kw. sets.



The Rotary Converters at Erith.

From among a large number of candidates the Council has selected Mr. A. Coveney to act as general manager of its tramways system. Mr. Coveney was at one time chief assistant engineer to the Isle of Thanet Light Railways and subsequently became general manager of the Ashton-under-Lyne Electric Tramways.

At the inaugural luncheon last Saturday, in replying to the toast "Success to the Erith Tramways," Mr. F. A. Stone, the chairman of the U.D.C., said that until they had a through connection with London the Council would depend on the townsmen for the support necessary for the success of the venture; but when they had obtained through running powers there would be no cause for anxiety in so far as prosperity was concerned. The proposer of this toast, in the course of an allusion to the probabilities of the extension of electric tramways in that part of Kent, expressed the view that they should be utilised at night time to bring dairy and garden produce into London and to the towns on the way.

Mr. W. C. C. Hawtayne presented Mr. Stone with a memento of the occasion in the shape of a handsome silver rose-bowl, and later on Mr. Hawtayne was asked, on behalf of the Council, to accept a gold pendant pass, permitting him to travel over the entire system at any time free of charge.

## THEORY AND PRACTICE.

By E. A. N. POCHIN, B.A., M.I.E.E.

"The science that defies the practitioner will remain sterile, it will simply not be used."

In common with the great majority of those whose electrical knowledge has been derived from the workshop instead of from the lecture-room, I had hitherto regarded the volt as being 1/1·434 of the E.M.F. due to a neat brass

box fitted with terminals and a thermometer; whilst the ohm was something very similar. Any lurking doubts, on the score of correctness, were promptly dispelled by finding that each was guaranteed to a higher degree of accuracy than the legal value, or any experimental determination.

However, on reading the recent discussion about units and standards at the Institution of Electrical Engineers, I became anxious to improve on this state of knowledge, and to see whether I could not calculate, from first principles, the dimensions of a standard ampere balance. Obviously, the first thing to ascertain was the way in which two circuits acted on each other, and I accordingly referred to two text-books, written by two eminent professors and Fellows of the Royal Society. One of these gentlemen informs me that—

"The relations between force and currents of a given form and strength may be deduced mathematically from the following theory, due to Ampère . . . . If the two short wires $m\ n$ and $m_1\ n_1$ be placed so as to lie in the direction of the line $d$ joining their centres, the force acting between them is

$$\frac{1}{2}\frac{c\ c_1 \times m\ n \times m_1\ n_1}{d^2}.$$

It is a repulsion if the currents flow in the same direction, an attraction if they flow in opposite directions."

The other professor states :—

"By the aid of this piece of apparatus Ampère further demonstrated the following points. . . . (*c*) There is in no case any force tending to move a conductor in the direction of its own length," and he further emphasises this point by discussing a case of "apparent mutual self-repulsion between contiguous portions of the circuit."

Thus, at the outset, I am confronted with two diametrically opposed statements, not merely about the properties of currents, but regarding Ampère's classical results.

And if there is in no case any force tending to move a conductor in the direction of its length, then how can a Lorenz apparatus work, and what becomes of the ohm? For we read that a Lorenz apparatus consists of a copper disk rotating in the plane, and cutting the field of a circular concentric exciting coil. Brushes are applied to the centre and rim of the disk, and expressions are given for the torque on the spindle when the disk is allowed to generate a current. Accordingly, the disk is held back by the action of the field coil, whilst the field coil cannot be urged forward by the action of the disk, because there is in no case any force tending to make the winding move in the direction of its length, *i.e.*, round the spindle—a distinct case of action without reaction.

Referring again to the same two books, I learn from the first that, according to Ampère, "the force with which two small lengths or elements of currents act on each other is in the direction of the line joining the centres of these elements," whilst from the second book it appears that, in general, these same elements will experience forces of rotation.

Despairing, therefore, of getting any reliable information regarding the first principles of the matter, I passed on to the formulæ. Book No. 1 states :—"Let a current traverse two wires in succession, each bent so as to enclose a circle of radius $k$. Let these wires be hung in parallel planes at a distance $a$ with their centres in the same axis. Then if the current be sent round the wires in the same direction they will attract one another; if in the opposite direction they will repel one another with a force

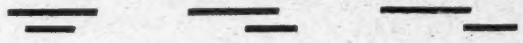
$$\text{F} = 4\ \pi\ c^2\ \frac{a}{k}."$$

Thus the force is proportional to the distance and inversely as the lengths of the wires—an obvious misprint you will say; but one which is repeated two lines lower, and which should not occur in a fourth edition. Moreover, the expression is utterly wrong unless $a$ is small compared with $k$, and this condition is omitted.

Once more I turned to book No. 2, and found :—

"$f = -\ 2\ c_1\ c_2\ l_1\ l_2/100\ r$"

$f$ being the force between two straight parallel conductors of lengths $l_1$ and $l_2$ carrying currents $c_1$ and $c_2$ separated by a distance $r$ which is specified as small compared with $l_1$ or $l_2$. The first thing noticeable on examination is that the expression is one dimension wrong in space. Passing over that, it will be seen that $l_1$ and $l_2$ may be in any of the positions indicated below :—



without affecting the value of $f$—a manifest absurdity. Thus, not only are the dimensions wrong; not only is the beginner confused, as always, about taking $c_1$ and $c_2$ in amperes or C.G.S.; but the entire expression is futile and misleading. I should have been less outspoken on the subject of this equation, if the general differential from which it is stated to be derived, and which is given four lines above it, had possessed any greater claim to accuracy. It is needless to point out that, so far as these two books are concerned, the ampere balance is an impossibility, and the ohm a myth.

Whilst searching for information in yet a third text-book by a third professor and Fellow of the Royal Society, I encountered a long proof based on Ampère's theory, showing that there is no radial magnetic force due to a long, straight conductor, as if such a point were capable of proof, instead of being a purely experimental result from which Ampère's theory must in part be deduced. By exploring the field of a conductor, we can ascertain the direction of the flux, and arrive at certain conclusions; but we cannot prove the experiment by the theory which is based on it. Such cyclical arguments, in which most educational works abound, are totally unprofitable and worthless. If anyone doubts this, let him try to prove mathematically that like poles repel each other, or deduce the wetness of water from the theory of surface tension.

Without dwelling on the systems of electrical units—the Frankenstein of the professor—misleading names and expressions are employed at every turn by those very persons whose duty it is to elucidate and instruct. Two examples will suffice :—"Magnetic force" which is not of the dimensions of a force at all; and "the negative resistance of the arc" which is merely a quibble in symbols.

In conclusion, I hope it will be understood that I have no desire to aim ridicule at those whose considerable attainments we must all respect; but I hope that in stating a case for the practitioner, based on actual difficulties encountered during the course of a most elementary inquiry, I may in some sort be contributing a single brick to help bridge the space which still divides the lecture-room from the work-shop—theory from practice.

## THE SPACING OF THE WIRES ON HIGH-PRESSURE POWER LINES.

By W. B. ESSON.

The High-Tension Transmission Committee of the American Institute of Electrical Engineers did a deal of valuable work in collecting particulars of power transmission practice from all over the States. Possibly sufficient time has not elapsed since the data came to hand, for much standardisation of details to have been done, nevertheless there are several matters which should not take much time to settle.

The three wires of a power line are in modern installations placed so as to form the three points of an equilateral triangle. Speaking generally, the side of the triangle should be as short as possible, provided it is sufficient to prevent the separate wires from swaying together in the wind, to ensure that short-circuits are unlikely to occur through other causes, and to render impossible an arc being sustained across the wires should one be accidentally started. The Niagara-Buffalo line when it was first put up had two three-phase circuits—six conductors in all—supported on a single cross-arm with 18 in. between the wires. To create firework displays, pieces of wire, barrel hoops, and other bits of metal used to be thrown over the wires, starting 11,000-volt arcs between them, which arcs would hold and would be blown by the wind to a considerable distance along the lines, to the great delight of the unauthorised experimenters. These conditions of working had apparently been

unforeseen by the designers, and in his paper read before the Canadian Electrical Association, Mr. P. M. Lincoln showed very clearly the necessity for giving them due prominence. "Put to the fresh college graduate," said Mr. Lincoln, "the problem of the amount of distance to be left between the conductors of a high-tension transmission line. His answer will involve most likely the jumping distance of the voltage to be used, the length of span, the sag, and perhaps a liberal factor of safety. It is experience only that will show that his premises are wrong, and that the equation to determine the spacing of high-tension wires depends very little on the voltages to be carried, and almost entirely on such things as the average length and ohmic resistance of cats, the spread of wing of owls and cranes and eagles, and the average length of scrap baling wire together with the strength of the average small boy's throwing arm." There is much truth in Mr. Lincoln's remarks, and very early experience on the Niagara-Buffalo line had emphasised them in a somewhat forcible manner. The conductors were accordingly rearranged, and the centre wire of each circuit was dropped on to a new cross arm fixed lower down which gave the wires the proper triangular disposition with a distance of 36 in. between them. An 11,000-volt arc would not hold at this distance while the lodgement of pieces of wire is with such centres, rendered very unlikely.

The distance between the wires should never be less than 24 in. for any voltage. In the 13,000-volt line of the Milano-Verese Railway, the wires are 20 in. apart, while in the Paderno-Milan 14,000-volt line and the Apple River-St. Paul's, 25,000-volt line they are 24 in. apart. So far as pressures up to 20,000 volts are concerned, it is evident that a spacing of 24 in. is quite sufficient, but if the lines are likely to be interfered with by evilly disposed persons, this distance may, with advantage, be increased to 36 in. Statistics of the installations at work in the States, show that this last dimension need not be exceeded until the pressure is above 30,000 volts, while for 40,000 volts 48 in. is about the right thing.

Up to the present, there has been no rule for the distance of the wires apart, as every engineer, guided possibly by local circumstances, has spread the wires according to his own views. In the first 40,000-volt installation, for instance, the wires were spaced no less than 9 ft. apart; in a later installation the distance for the same pressure was reduced to 3 ft. 6 in. The Washington Water-Power Co. recently put up a line 100 miles in length, in which the wires were spaced only 3 ft. 6 in. apart, to operate ultimately at 60,000 volts. This certainly seems very close spacing for such a high pressure, and in this respect it stands alone amongst the newer installations. The spacing on the new lines of the Missouri River Co., the California Gas and Electric Corporation and the Guanajuato Power and Electric Co. is in accord with what experience dictates. On these lines the distances between the wires are 6 ft. 6 in., 6 ft., and 6 ft. 7 in. respectively, the working pressures being 57,000 volts for the first, which is 65 miles long, and 60,000 volts for the last two. In the new line of the Shawinigan Water and Power Co., which is operating at 53,000 volts over a distance of 84 miles, the spacing between the wires is 5 ft.

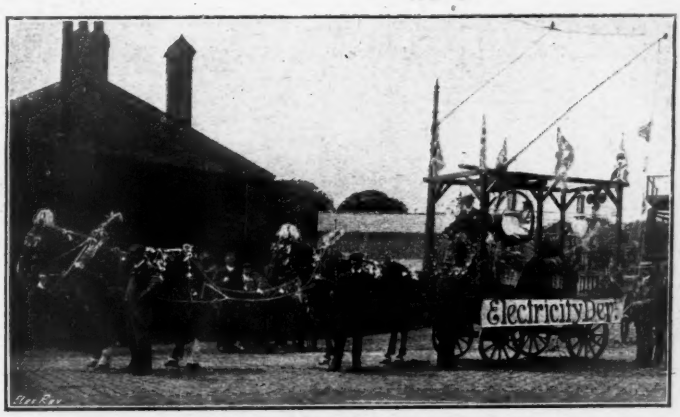
The new schemes are fairly consistent, and, generally, it is found that the distance between the wires in feet is about equal to the working pressure in volts divided by 10,000. Now that we have sufficient data to hand, it would be well to adopt a general rule for the spacing, thus doing away with the needless and useless variations from the average. To this end the writer proposes that a uniform standard spacing be adopted of 1 ft. for every 10,000 volts pressure with a minimum spacing of 2 ft. According to this, a 60,000-volt transmission would have the wires spaced 6 ft. apart; a 50,000-volt, 5 ft.; and a 40,000-volt, 4 ft. For 20,000 volts the standard spacing would be 2 ft., which might be increased to 3 ft. if the lines were likely to be tampered with, but 2 ft. would be the minimum for any lower voltage.

## POPULARISING ELECTRICITY.

Those who are responsible for the management of electric light and power plants are finding that it pays to exercise their brains a little in conceiving ingenious methods of advertising the commodity which they are engaged in selling. The publicity department is becoming as necessary for the working of a progressive electricity supply business as it is for machinery and accessories manufacturers. We withhold our regrets that it has not been more readily recognised in the past, in the satisfaction that many undertakings seem now to be awakening to the importance of using every reasonable means and opportunity for popularising the uses, merits and advantages of electricity for all sorts of purposes.

One of the most interesting efforts to secure the interest of the general public in such matters is the subject of the accompanying illustration which hails from Nelson, where Mr. W. Alan Fraser, the borough electrical engineer and tramways manager, is displaying a spirit of enterprise in appealing to possible consumers. Our photograph represents an electrical exhibit which was made by his department on the occasion of a recent trades demonstration in the town. The car contained motors and fans running, also radiators and arc lamps lit up. Current for the purposes of the car was obtained from the overhead tramway conductors as will be seen, and the return was effected from a shoe running on the rail.

The Managers and Executive Committee of the Olympian Electrical Exhibition, which, by the way, is going to "make things hum" in London before many weeks are past, might




Advertising Electricity at Nelson.

do worse than take a note of what Mr. Fraser and some of the more enterprising members of his cult are doing in different parts of the country by introducing taking novelties to fix the attention of the public.

## ACTUAL COST OF ENERGY USED IN DRIVING A SMALL ENGINEERING WORKS.

The following particulars have been supplied to us by a firm of engineers in Lancashire, thinking they may be of interest and use to some of our readers.

The works have been equipped with motors powerful enough for dealing with a larger volume of work than is at present going through.

The various classes of tools are grouped together so as to be driven off line shafts as short as possible, and all are driven by means of cross belts and countershafts in the usual way, except two hoists and a ventilating fan which have each a separate motor.

The motors are mostly of fairly low speed, and they drive the line shafts direct without the intervention of countershafts for speed reduction.

It will be noted that the average power developed, is only about one-eighth of the total power installed. This is due to the fact that only four of the motors are running constantly, the others are started and stopped intermittently as required and, by apparently a law of averages, never all come on at once, as is clearly shown by the accompanying records of the voltage and amperemeters, which are installed in the switch room and put into use occasionally.

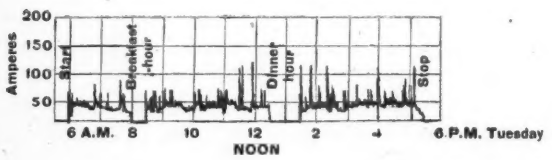
This wide distribution allows of plenty of space being reserved for finished and partly finished machines and parts, between the various working departments, and thus facilitates the handling of the machines and allows for storage whilst waiting to be passed on to the next department.

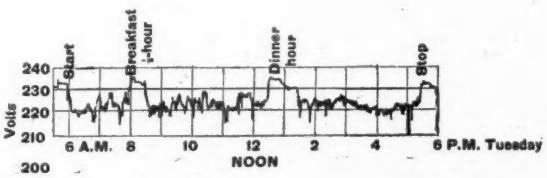
It would be interesting to know what the power required would be if this plant had been driven direct from a single gas engine on the ground floor.

TABLE I.

| Motor No. | Power. | Speed. | Position. | Floor. | Tools driven. |
|---|---|---|---|---|---|
| 1 | 5 H.P. | 1,100 | Smiths' shop. | Ground floor. | Fan for brassfounders', coppersmiths' and blacksmiths' fires, planishing hammer and emery wheel. |
| 2 | 12 H.P. | 680 | Pattern shop. | 1st | Surfacing machine, 2 circular saws, band saw, lathe and drill. |
| 3 | 5 H.P. | 650 | Tool room. | 1st | Tool grinders, &c. |
| 4 | 8 H.P. | 560 | Turning shop. | 1st | 7 lathes, grind stone, emery wheel, &c. |
| 5 | 8 H.P. | 560 | Machine shop. | 1st | 4 drills, 2 shapers, 2 slotters, miller, planer, &c. |
| 6 | 8 H.P. | 560 | Brass finishers. | 2nd | 17 lathes, 3 drills, 2 shapers, emery grinder, &c. |
| 7 | 8 H.P. | 560 | Testing shop. | 2nd | Testing finished machinery. |
| 8 | 5 H.P. | 650 | Polishing shop. | 2nd | 2 polishing machines for brass work. |
| 9 | 6 H.P. | 850 | Hoisting. | 3rd | Cage hoist, to lift 1 ton at 35 ft. per minute. |
| 10 | 14½ H.P. | 750 | Hoisting. | 3rd | „ „ „ 4 tons at 20 ft. „ , or 2 tons 35 ft. per minute. |
| 11 | 2½ H.P. | 360 | Ventilating. | 3rd | Coupled direct to blower exhausting air from brass foundry and coppersmiths' shop on ground floor. |
| | 82 H.P. | Total | | | |

The motors, Nos. 1, 4, 5 and 6, run about 53 hours per week, the others run as required. The current is obtained




from the Corporation at 220 volts, and the charge is 1½d. per unit for the first 1,500 units, afterwards 1d. per unit; accounts are payable quarterly, and 5 per cent. discount is allowed, as shown in the following table :—

At least three or four times as much shafting would have been required, and it would have had to run constantly during working hours all over all the floors, as power is required every moment in one part or another.

The accompanying charts are interesting as showing how comparatively small is the fluctuation in power absorbed

TABLE II.

| For quarter ending. | Energy used as per Corporation invoices. | Discount allowed 5 per cent. | Actual net cost per quarter. | Average cost per unit. | Hours worked as per time books. | Average cost of energy per hour. | Average units used per hour. | Average brake horse power, allowing 850 watts per B.H.P. |
|---|---|---|---|---|---|---|---|---|
| | | £ s. d. | £ s. d. | Pence. | Hours. | Pence. | Units. | Brake H.P. |
| Sept. 30th, 1904. | 1,500 units at 1½d. = £9 7s. 6d.<br>3,654 „ „ 1d. = £15 4s. 6d.<br>5,154 Total units consumed | 1 4 7 | 23 7 5 | 1·088 | 563 | 9·78 | 9·15 | 10·74 |
| Dec. 31st, 1904. | 1,500 units at 1½d. = £9 7s. 6d.<br>3,791 „ „ 1d. = £15 15s. 11d.<br>5,291 Total units consumed | 1 5 2 | 23 18 3 | 1·084 | 577 | 9·94 | 9·17 | 10·76 |
| March 31st, 1905. | 1,500 units at 1½d. = £9 7s. 6d.<br>4,760 „ „ 1d. = £19 16s. 8d.<br>6,260 Total units consumed | 1 9 2 | 27 15 0 | 1·064 | 722 | 9·22 | 8·67 | 10·20 |

It will be noted that the last of the three quarters given works out at a slightly less rate than the two previous quarters. This is probably due to the fact that during the last quarter some extra time was worked, during which there would not be so much hoisting for loading purposes and possibly one of the regular running motors may have been stopped for a part of the time.

To show the distribution of the power, we may add that the works measure about 120 ft. × 60 ft. in plan and are four stories high ; as shown in table No. I. the motors are on each of the four floors and they also cover from end to end and side to side *on either one or other* of the floors.

considering that it is quite possible (though evidently not probable) for the load to run up to 50 or 60 H.P. at any time.

**Names Wanted.**—The BRITISH EMPIRE MOTOR TRADES ALLIANCE has received an inquiry for the names and addresses of British firms who manufacture front axles and rear live axles complete, for motor-cars. British manufacturers of the above are requested to communicate with J. B. King, secretary, 11, Red Lion Square, W.C.

## NEW LAMP FOR FLICKER ADVERTISEMENTS.*

The Allgemeine Elektricitäts Gesellschaft has recently introduced an incandescent lamp, which, by means of an automatic make and break arrangement, is periodically extinguished at short intervals of time, and so forms a convenient element for the construction of flicker advertisements without the aid of any additional apparatus. The working parts are contained in a small lampholder (shown in

Fig. 1.

fig. 1), suitable for taking any ordinary incandescent lamp, and the method of operation will be clear from fig. 2. The mechanism consists simply of a small heater, similar to those used in Nernst lamps, and a contact closed through a special spring. This spring is made up of strips of two dissimilar metals welded together, the metals being chosen so as to have different coefficients of expansion. When cold the spring is straight and closes the circuit as shown by the full line in fig. 2, but as soon as the lamp current passes

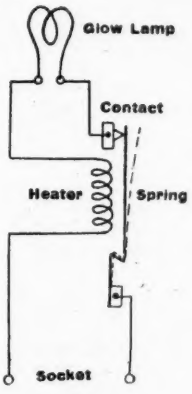



Fig. 2.

through the heater coil, the spring becomes heated, bends over as shown by the dotted line in fig. 2, and breaks the circuit. The heater then cools down again, the spring straightens out and closes the circuit once more, and this process repeats itself automatically at regular short intervals.

By simply inserting one of these special lampholders, therefore, between an ordinary lampholder and the lamp, the latter will light up and extinguish itself periodically. When a large number of such lamps are combined to form an advertisement, though the time intervals between successive illuminations in the different lamps may be alike, the exact instants at which the lighting up and extinction occur will differ in the different lamps and will produce a peculiar flicker eminently calculated to attract attention.

**Steam Turbines.**—After paying 12½ per cent. dividend for the year, Messrs. R. & W. Hawthorn, Leslie & Co., Ltd., have set aside £10,000 for extensions and improvements of plant on account of the introduction of turbines.

* *E.T.Z.*

## CORRESPONDENCE.

*Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### Some Arithmetical Questions for Mr. Byng.

Writing also from a secluded region, the scene of a now ruined industry, which flourished in earlier protection days, namely, that of evading protective duties (more vulgarly known as smuggling), I have at hand only a few recent technical papers, and none of the blue books which Mr. Byng despises, nor any fiscal literature.

May I say at once that I do not for a moment question Mr. Byng's sincerity, but that I do still question the soundness of his deductions, despite Mr. Lemmen's earlier gibe at the rule of three? As to Mr. Byng's endeavour to follow my train of thought, I am glad to have his reply to my first question, that he does not accept the Board of Trade returns "as correct and truthful indications of the state and tendency of the electrical industry." Neither do I accept the mere figures of imports and exports as affording all the information a statistician or even a plain citizen requires. Time and again I have pleaded for statistics of internal trade. But I must still asseverate that, judged by figures of import and export trade, the electrical industry is in anything but a ruined condition. As to the general unreliability of Board of Trade returns, when a certain book called "Protection" was written, its author being desirous of *proving* that the country of his adoption was living on its capital, did not hesitate to quote the sums total of import and export trade. I am quite aware that Customs' declarations lack infallibility, and as an electrical engineer as well as a student of statistics—classifications of articles being sadly unstandardised—I am interested to hear of the way in which meters may be imported. It would not be uninteresting if Mr. Byng's reminiscences go so far back, to hear more about importers' delinquencies, say, in regard to telephone sets.

May I point out that re-exports of foreign and colonial merchandise are separately computed in the Board of Trade returns, and, further, that exports of British and Irish produce are returned as "wholly or mainly manufactured in the United Kingdom." Among the latter are submarine telegraph cables, in regard to which neither the conductors nor the bulk of the dielectric substances are produced in this country. Now, to an electrical manufacturer, the prices, say, of copper, rubber, jute, and cotton, are matters of moment. Mr. Byng would not fetter his industry by taxing these. Yet the umbrella maker is held up to scorn because he imports silk, frames and sticks from abroad, to be stitched into English umbrellas.

Finally, Mr. Byng's moral. Every loyal citizen of a constitutionally governed country will, nay must, repudiate the dictum that "the question of our unemployed should be decided by the man who employs—the manufacturer." To each citizen his rights. From the point of view of the ant-lion, the ants were created for his special behoof. A manufacturer speaking in this strain, even from among the philosophic calm of the Cotswolds, savours of feudalism, serfdom, and the planters who convulsed a continent because of their claim to the sacred right to wallop their own niggers.

No, Mr. Byng! To each citizen his rights. To the manufacturer to advance his views, and to "otherwise well-meaning men" to advance theirs. In the case of the ant-lion *v.* the ants, the appellant must not constitute himself both judge, jury and executioner. The writer, with others, looking upon the electrical side of the fiscal question, not alone from the point of view of the manufacturer seeking higher dividends, sees vast conflicting interests requiring study. In earlier pages of the Electrical Review I have quoted the remark of a leading Free Trader as to the natural tendency of every man to be a protectionist so far as his own industry is concerned. It is when one gets beyond this rut of isolation, this sand-pit of the ant-eater, one can consider other interests, such as those of the ants. At any rate, with all its short-comings—and Free Trade is not immaculate—Free Trade seems to the writer to be the solution making for the maximum of justice. Arithmetically, the question at issue

between Mr. Byng and myself is for the moment closed. If statistics—meagre though they be—are used one day and repudiated another, we have no common ground on which to argue. But will Mr. Byng, and other readers of your journal, consider whether complete figures, giving internal as well as external trade, as accurately as is humanly possible, would not be worth having?

**W. Pollard Digby.**

Sennen Cove, near Land's End,
*August 26th*, 1905.

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### Method of Testing for Insulation of Overhead Network.

I notice that Mr. S. Worthington sends a suggestion to your current issue relating to an apparatus for testing overhead insulators; and, while appreciating the interest which the article on "The Prevention of Overhead Accidents" has aroused, I should like to draw Mr. Worthington's attention to the fact that his method of testing is identical with the method of which I wrote, but that the apparatus which he describes does not seem to me to be so convenient as that which I described and illustrated.

In the first place, the light fuses by themselves are more reliable and handier than lamps; and, secondly, I do not gather what advantage is gained by using lamps and fuses in series.

If the fuses blow, the indication of the lamps is not needed, while the fact that the breaking of the filament of either lamp and the blowing of either fuse might pass unobserved, adds an element of uncertainty to the test, which is not present to such a degree when using my apparatus.

Moreover, I should say that the apparatus suggested by Mr. Worthington is not intended for testing both the primary and secondary insulation without moving the tower wagon from the first position under or near the primary insulators, a particularly important feature of the simple apparatus described in my article.

The claim that "by this test it would be impossible to do any damage at the power station, as the S.P. fuses in the case would blow first," rather indicates that the methods of testing within the knowledge of your correspondent are in considerable need of overhauling, and I am glad to see that he at least does not approve of them.

**Robert N. Tweedy.**

*August 25th*, 1905.

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### Mains Testing.

Mr. Knight is evidently not in favour of using heavy currents in a loop test, which is neither more nor less than a drop of potential method under another name, the drop in potential being measured on the potentiometer.

Three paragraphs further on he states that "The simplest of all methods of locating faults exactly is the fall of potential method, in which you send the biggest available current within limits of safety along the cable." Surely what is good in one case must be good in another, and a drop of ·005 volt can be more easily measured than ·000002, whether by voltmeter or potentiometer.

**David Smith,**
*Assistant Electrical Engineer.*

Tunbridge Wells Electricity Works,
*August 29th*, 1905.

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### The I.E.E.

If "silence gives consent," the absence of any further letters in your columns anent the old grievance of the I.E.E. subscription is, I think, indicative of the predominant wish of provincial members that the subscription should, in their case, be reduced.

As a student some 10 years ago I used to pay 10s. 6d. per annum, and in return for this I could use the library, attend all the meetings and benefit in many ways by these gatherings, also getting a free supper thrown in once a month. For the past five years I have paid £2 2s. per annum, and get none of the above advantages, and I cannot even profit by my membership to the small extent of being able to get reasonable and comfortable quarters any time I should happen to be in town, as would be the case were I to transfer this subscription to some club.

Can anyone say wherein lies the value of membership to

**A Provincial A.M.I.E.E.**

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## REVIEWS.

*Das Funken von Kommutatormotoren mit besonderer Berücksichtigung der Einphasen-Kommutatormotoren.* By F. Punga. Hanover: Gebrüder Jänecke. Price M.4.

This book forms a timely contribution to the commutation question, more especially to that latest development of the question which is concerned with the numerous types of single-phase commutator motors, although the direct current machine is also fully dealt with.

A general knowledge of modern views on commutation is assumed throughout, even to the extent of occasional obscureness, although the treatment is, on the whole, clear as well as unmathematical.

The fundamental commutation equation is stated as:— $E f = E i + E r$, where $E r$ is the reactance voltage of the commutated section.

$E i$ is the voltage induced in the section from outside, and $E f$ is the voltage which must be introduced into the short circuit by means of the brush contact resistance in combination with unequal current densities under the toe and the heel of the brush.

$E f$ is called the "sparking voltage," because the tendency to spark depends on its value, and only by keeping it within certain well defined limits, depending on the brush quality, can a satisfactory commutation be obtained.

The reactance voltage $E r$ is estimated by means of Hobart's well-known rule, except that the more generally applicable *average value* of this voltage is dealt with, in place of the *maximum* value on the assumption of a sine wave current, as adopted by Hobart.

Starting from the above simple relation, the effects of brush shifting, compensating windings, brush quality, brush contact resistance, resistance of commutator connectors and brush thickness, on the commutation of direct-current machinery, are considered in the first 30 pages. A few pages are then devoted to a little understood point in connection with commutation, viz., the effect of the ampere-turns of the short-circuited coils in weakening or strengthening the field, and it is shown that, even with the brushes set on the neutral line, these coils can either weaken or strengthen the main field appreciably according to the commutation conditions.

The next 30 pages deal with the sparking problem as it affects the three principal types of alternate-current commutator motors, viz., the series motor, the repulsion motor, and the compensated repulsion motor (Latour or Winter-Eichberg motor). The consideration of the commutation problem of course involves the investigation of the whole action of these motors, so that these pages also contain a simplified, though fairly complete, theory of the motors.

In the second portion of the book, the general principles governing the design of direct and alternate current commutating motors are discussed in detail, and designs for 60-B.H.P., 25 ~, 500-r.p.m. motors of the series, repulsion and compensated repulsion types respectively, are worked through fairly comprehensively.

In an appendix at the end of the book a more exact theory of the repulsion motor is outlined, in which the effects of some of the less allowable assumptions (such as the assumption of sine wave flux distribution and of excitation by means of an additional stator winding instead of by shifting the rotor brushes) are considered, and the necessary corrections indicated.

The book is valuable as collecting and amplifying the results of numerous recent papers in the technical Press on alternate current motors, as well as for its clear and up-to-date discussion of the commutation process in direct current machinery.

*Gas Engines and Producer Gas Plants.* By R. E. Mathot. London: Crosby Lockwood & Son. 1905. 12s. net.

This work has been translated from the original French manuscript by Waldemar B. Kaempffert, has a complimentary preface by Dugald Clerk, M.I.C.E., F.C.S., and is well illustrated.

The author describes it as "a practical treatise setting forth the principles of gas engine and producer design, the selection and installation of an engine, conditions of perfect operation, producer gas engines and their possibilities, the care of gas engines and producer gas plants, with a chapter on volatile hydrocarbon and oil engines."

The volume contains over 300 pages of clearly printed matter, and the author's introduction is dated March, 1905. The 15 chapters bear headings as follows:—I.—Motive Power and Cost of Installation; II.—Selection of an Engine; III.—The Installation of an Engine; IV.—Foundation and Exhaust; V.—Water Circulation; VI.—Lubrication; VII.—Conditions of Perfect Operation; VIII.—How to Start an Engine; IX.—Pertubations in the Operation of Engines and their Remedy; X.—Producer Gas Engines; XI.—Producer Gas; XII.—Pressure Gas Producers; XIII.—Suction Gas Producers; XIV.—Oil and Volatile Hydrocarbon Engines; XV.—The Selection of an Engine.

Such a sentence as occurs on p. 69—*i.e.*, "It seldom happens that the leakage of a pipe 30 to 50 ft. long, supplying a 30-H.P. engine, is much less than 90 cb. ft. per hour," is probably due to an error in translation or printing, as is also the case in paragraph 19, p. 299, where the "cost per B.H.P. per hour in anthracite is given as 62 gallons."

One of the notable features of the work is the absence of reference to large power gas engines, such as are now being extensively installed for use with blast furnace and producer gases. Indicators are very briefly referred to, the author stating, on p. 284, that "indicator cards are in themselves inadequate, and should be supplemented by the records of explosion recorders"; this remark is followed by a description of the latter apparatus as designed by himself. Further, he considers that "the brake test gives but crude results at best."

However, the work contains much useful information in regard to all the points included in the headings of the chapters, and that on producer gas gives also the procedure to be followed in cases of carbon monoxide asphyxiation. The particulars relating to gas producers, both of the pressure and suction systems, are very exhaustive, and will be of much service to those who are considering the adoption of producer gas plant.

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*Hydraulic Power Engineering.* By G. Croydon Marks. London: Crosby Lockwood & Co. 1905.

The author commences his work with a chapter on water, and it serves to show the difficulty connected with all measurement to read that the Board of Trade has fixed the weight of water at 62° F. at 62·2786 lb. per cb. ft. What a fine opportunity for argument is here for the "coincidentalist," who would have all manner of exact coincidences! Let him fix the cubic foot or the pound at such a figure that at 62° F. there shall be 62 lb. of water per cb. ft. At 39·3° F., the temperature of maximum density, there are 62·425 lb. of water to the cubic foot.

Water is compressible 0·00005 of its volume per one atmosphere of pressure. At a pressure of 1 ton per sq. in. water is compressed 13 cb. in. per cubic foot.

The author then deals with the flow of water through orifices and in pipes, and follows this by a chapter on practicable pressures, 2 tons per square inch being a useful pressure to employ where the work to be done is mainly press work. Curiously enough, cast-iron is a favourite metal with the hydraulic engineer, and its reputation has too often been damaged by bad design, examples of which are given. The author pays considerable attention to the question of materials and tests of same, and discusses that vexed question of pressure in a thick cylinder.

The detail of packings is then dealt with at some length. Needless to say, this detail is the most important, for more troubles arise in connection with packings than in ny other direction. If any reader has ever hired an ydraulic jack for use in the country far away from fresh packings, he will be painfully aware of the fact that the hirer invariably sends out hydraulic jacks with burst U leathers, and with grit under the valves of plungers, and never by any chance sends a spare leather on the most urgent of work. Thus the use of hydraulic plant is often an occasion of blasphemy where it ought to be a pleasure; for a well-conditioned hydraulic jack that will pull up great driven piles, and move mountains, as though it were faith itself, is indeed one of the pleasantest tools that an engineer ever needs to employ. Pipe joints are well illustrated, also valves, both stop and control. With Part V. commences the treatment of hydraulic machinery, and the consideration of balances, of multiplying movements, safety appliances, &c.

The latter part of the book is concerned with pumps, turbines and hydraulic motors, and there is a final chapter which treats of recent achievements in dock work, bridge work—the Tower Bridge lift span and machinery being described—water-balance railways, such as that of Lynton, hydraulic forging presses, &c.

The book is sound and practical, and to be recommended.

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*The Theory of Experimental Electricity.* By W. C. D. Whetham, M.A., F.R.S. Cambridge: The University Press. 1905.

The importance of the new fields of research which are being explored by physicists and electricians has altered considerably the relative values of the branches into which experimental electricity is usually divided. If the student is to be suitably equipped, so that he may be ready to make a research with some prospect of bringing it to a successful issue, he must not only have an accurate knowledge of the theory of his own branch of the subject, but must also know the elements of the theory of the many allied branches. The student usually attempts to acquire this knowledge by a hasty perusal of treatises on the various subjects. Unfortunately, even with the best guides, the acquisition of accurate knowledge is laborious, and so he is apt to get disheartened, and exhaust his energies in reading the most easily understood portions, which are often of little practical importance. To students in this plight, and in theoretical matters we are all students, we heartily recommend Mr. Whetham's work.

Before reading this book we must loosen our hold on any preconceived notions we may have, and be ready to accept those conclusions which follow logically from the premises obtained by careful and accurate experiments. The object of the author is not to confute the opponents of the new theories, or to enter into wordy battles with philosophers, but to teach. Mr. Whetham's unique knowledge, not only of the most advanced theory but also of all manner of experimental methods, as well as his gift of clear exposition, admirably qualify him for the task.

In the earlier chapters the author describes the "fluid" theories of electricity, and points out that Poisson, Green and Kelvin calculated the density of the distribution on conductors of various shapes, thus verifying Coulomb's experimental results. The dielectric next became the centre of interest; Faraday's tubes of force and Maxwell's equations concentrating the attention of physicists on what is happening in the surrounding medium.

They are now, however, evincing a laudable curiosity as to what is happening at the ends of a tube of force, and this will doubtless lead to important advances.

In the chapter on the electric current, a clear description with an easily understood theory of Heaviside's "rational current element" is given. The student is thus enabled to understand how the magnetic effects due to flights of charged particles can be calculated.

We are sorry that the author has not discarded "specific resistance" in favour of "resistivity." A good description is given of Callendar's recorder and the theory of the platinum thermometer. The chapters on thermo-electricity and on units are very thorough. The chapter on electromagnetic waves and the proof that $v = 1/\sqrt{k\mu}$ will be particularly appreciated by wireless electricians. The author criticises the attempt to find the values of the refractive indices for infinite wave lengths by means of Cauchy's formula. "Any comparison by such methods of the dielectric constants and the refractive indices still remains unsatisfactory." We were under the impression that Fleming had shown that at the temperature of liquid air all the dielectric

constants represented by large numbers became normal, and were very approximately equal to the square of the index of refraction for infinite wave lengths as determined from Cauchy's formula.

The chapter on electrolysis is an excellent introduction to Mr. Whetham's "Theory of Solution." The chapters on the "Conduction of Electricity through Gases" and on "Radio-activity," which finish the volume, are exceedingly useful. They will be welcomed by all who have attempted to make a *précis* of the standard works on the subject.

The following extract will give readers who are not familiar with Mr. Whetham's writings some idea of his style. At the end of the chapter on the conduction of electricity through gases, he says: "The ionic theory of electrolysis gave a clear idea of the mechanism by which the slipping of the ends of the tubes of force occurred in conducting liquids, and the corpuscular hypothesis gives us an equally vivid insight into the nature of the process within metallic circuits. The tubes, anchored by their ends to an ion in electrolytes, or to a corpuscle in metals, drag their anchors. It is the slip of the anchors that constitutes the current, and the heat developed by the passage of the current is to be explained by the frictional resistance to the drag of the anchor, or to some other means of dissipating energy, such as inter-corpuscular radiation, not yet fully understood."

In conclusion, we would advise electrical engineers to read this work. It is short, well-balanced, well written, and has an excellent index. No electrician can afford to be ignorant of the theory of experimental electricity, and there is no pleasanter way of learning it than reading this book.

A. R.

## ACCUMULATORS WITH REVERSIBLE BOOSTERS FOR FACTORY INSTALLATIONS.

By RALPH W. BIRKETT.

(*Concluded from page* 322.)

But there are other uses for the battery and booster than its functions of load and pressure governor, and perhaps a few instances from the writer's experience, in which the battery came to the rescue and the booster proved "a friend in need," may interest engineers who have similar difficulties occurring.

Take a case where the boiler plant is loaded up by the day load, or a boiler is under repair. As darkness comes on, lamps are switched on, the steam pressure falls, the engines slow down, and the volts drop.

The power station telephone is kept busy, and nasty remarks are made about gas and candles. The engineer tries to explain politely about the leaky boiler tubes, &c., but no one seems to sympathise, and things are uncomfortable.

But suppose he has a battery "up his sleeve," the trouble is easily got over. The writer has had a boiler to shut down just as the lighting load was coming on, the steam pressure fell from 120 to 80 lb. sq. in., the engine from 360 to 280 r.p.m., and still has been able to keep 410 volts on the mains. Also a main steam joint has gone, but he has still been able to keep the works lit and the motors in machine shops running to keep some hundreds of men going.

Or if extensions have been made and the existing plant is loaded with the day-load, instead of putting down more boilers, engines and dynamos, a battery and booster will work out cheaper, and owing to the economies they will be effecting *all the time*, by securing more efficient running of the engines, will undoubtedly pay better than an engine which must be idle most of the time.

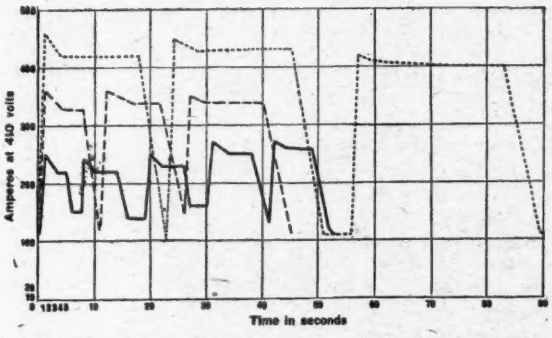
Considered as spare, or emergency plant, the battery has claims to usefulness.

Returning to an actual experience. It was found necessary, in order to make certain improvements in the machine, to return the rotary transformer before referred to, to its makers. No spare 100-volt plant was at hand. The cells were of the modern type, with burnt-on connections. To supply the current for 100-volt crane work and glow lamps (100-200 amperes), the battery was cut up into three sections of 65, 66 and 66 cells. These three sections were coupled in parallel together for discharge during the day. At night they were reconnected in series (with tappings taken off each section in turn—1 and 65, 66 and 131, or 132 and 197, with a regulating resistance, for night lighting) and charged. This worked fairly well, but as 66 cells gave 140 volts, a lot of glow lamps were burnt out. The booster, therefore, was specially arranged to work with the battery in sections to reduce the 140 volts to 100 volts during the day discharge, charging the cells in the ordinary way during the night. This arrangement worked well for five months, until the rotary transformer came back. Without the battery, no incandescent lighting could have been done, and four electric cranes would have been rendered temporarily useless, and this would have meant a loss of hundreds of pounds in the extra expense of handling work in the shops, loading and unloading material, &c.

The best regulated batteries, however, suffer if neglected or misused.

The specific gravity and voltage of a cell here and there may, through an unobserved contact or other cause, be found lower than its neighbours.

In such a case, the engineer was advised by the makers of the battery, that the only way to restore the faulty cells was to boost each separately. The usual practice of cutting out during discharge, and connecting up only for charging of low-reading cells, could not be resorted to, as the connections were not bolted, but solid. Increasing or lengthening the




Load Fluctuations of Rolling Mill Motor (see page 322).

charge would have done injury to the other cells, besides wasting current. (A cell brought low by an internal short-circuit, although the contact be removed, will never recover, but grow rapidly worse if not boosted, until it becomes "dead.") The only way to boost these low cells was to use a small motor-generator or "milking booster" giving the necessary low voltage. On inquiry it was found that this machine would cost £60—£80.

Instead of buying it, however, a special connection of the Highfield booster was worked out, and answered admirably.

But the machine charging two or three cells, leaving the whole battery floating on the bus-bars, felt every variation of the line pressure, the field of the booster being, of course, very weak to bring its armature pressure down to the required low voltage. It was, therefore, arranged to do the boosting of the low cells at night, and the arrangement used was as follows:—The booster motor was connected across the 197 cells, the diverter winding was cut out of the booster field, and the volts across its armature adjusted so as to charge one, two or three cells at about 30 amperes (which current was found to give much better results than a higher rate), and perfect steadiness was thus obtained as low as 3 volts. So that the battery, being isolated, was made to give a boosting charge to any of its own cells. In fact, it has been used, so connected that whilst giving current direct to the main bus-bars, it has at the same time been running the booster to charge groups of its low-reading cells. Thus 197 cells were in series; and Nos. 4 and 5, 27 and 28, 145 and 146 (or any pairs of cells) were being boosted two in series, these several groups being in parallel across the booster armature generating 90 amperes at, say, 6 volts (the latter, of course, depending upon the state of the cells), whilst the

battery could give current to the mains for the night load for lighting and power. Boosting must be effected at a low current, and sometimes takes a long time, but in this way it was possible to work up several groups at once, and so much time and trouble was saved. The arrangement which could be left to itself for hours together, was easily fixed, and thus the expense of an £80 milking booster for only occasional use, was saved.

In many works there are times when the load is only light, and economies in running expenses could be effected if a battery were available, especially at night, or for overtime work. Take the case of an engineering works, such as the plant from which these experiences were gained, was serving. Very often there would be an odd motor, with a glow lamp or two, running overtime or all night.

There were always 100-volt glow lamps for the boiler house, time office, &c., all night; also a few arc lamps, and sometimes a crane in the steel works on 410 volts. The rotary transformer would be run for the 100-volt circuits, and with the arcs, &c., the load would be about 15 KW., for which a 90-KW. dynamo would have to run 11 hours, a boiler be kept under steam, with a stoker, driver and lamp attendant, so that when the night shift was small the cost of running the few motors and lamps was very high.

The difficulty was that, through having to run the transformer, although its output was small, its light load losses caused the 11 hours' consumption to require more than the battery could supply, so that the engine, with all its attendant expenses, was a necessity. Here the booster came in again, however. The engine was run until 7 p.m.; then, with the booster cut out, the battery was placed direct across the bus-bars. The booster was then run by its own motor as a generator at such a speed as to keep 80 volts (its maximum pressure) across its armature. Such 100-volt lamps as were required in the night were replaced by 80-volt lamps and put on the booster. Thus the battery was able to serve both the 410 and 80-volt circuits. Coal, and the driver and stoker's wages were saved, and the light load transformer losses (45 KW.-hours) avoided.

The booster required only an occasional look in by the lamp and motorman, who also did other work. When the day shift men came on at 5.30 a.m., connections were changed, generators run up, and the battery put on to charge up.

A point may be noted here. The battery could be charged, and would still regulate the mains volts and generator load. Any sudden demand on the mains would simply take from the battery charge what was required. When being specially charged in this way, the practice was to set the booster at slightly over the proper charging rate, and this would keep fairly steady. As the battery volts rose, a little more boost was given automatically until the booster volts plus generator volts equalled 2·4 volts per cell. The charge was then reduced, and allowed to die out of itself, thus the battery never got overcharged. When fully charged, so long as the battery volts are higher than the bus-bar volts, the booster will *reduce* the pressure to the line pressure if the battery is called upon to discharge. As the battery pressure falls by continuance of discharge the booster reverses and begins to *raise* it to the pressure required for the line.

When discharge is finished the booster again reverses (the line being now higher than the battery), and reduces the line pressure to allow a proper charge to enter the battery. As the battery pressure rises it again reverses, and begins to add to the line pressure as required until the battery is full, when until called upon to discharge again the pressure of the booster will remain at zero.

By this automatic action of the Highfield booster, very little attention is required; the machine will run all day without being touched—although so many other things can be done with it, if desired. But ordinarily one man can attend to both engines and switchboard, and, with occasional help in cleaning up, &c., look after all the running machinery in a large power station.

It will be seen from the foregoing notes that the battery instanced has had some pretty severe usage, and it may be asked what effect the intermittent charging and discharging, and constant reversals have had upon the cells. In this case no injurious effects can be observed; after two years' use, the plates are in first-rate condition, and the full guaranteed discharge capacity can be obtained.

Of course, the battery has had regular and skilled attention. A weekly inspection and test of specific gravity and voltage of each cell, reveals any irregularities, internal contacts soon show in the test and are at once attended to. No repairs have been required, the cells will not want cleaning for another year, and the plates are all in equally good condition.

The use of a battery and automatic reversible booster offers many advantages to the works engineer as well as in the central station. Steady running of all motors and lights, whatever their working conditions, is important in the workshops.

Simplification of the wiring and economies effected by putting power and lighting together, may save a great deal of cable. Running only such engines as are actually required, and being able, in spite of fluctuations in the demand for power on the mains, to keep them at their full load, or at least a steady value of it, adds to their efficiency, and saves coal and wages.

The extra boiler and engine power required for lighting and only used for a small proportion of the working hours, may well, in a new plant, be replaced by a battery. In case extensions are required to an existing plant, the question of putting in a battery should be carefully considered. In some cases satisfactory working of a mixed load could not be obtained without it, and in every case it would improve the conditions. For night work it requires less attention and works more economically than the engine would usually do.

In times of breakdown, emergency, or for special requirements, the battery is always a friend. A little ingenuity will enable the engineer to overcome many difficulties, and the booster can be put to many uses.

The writer has not made any attempt to go into the theory of batteries and boosters. They are extremely interesting to study, but even more interesting to see working.

The use of them in factories or works deserves more attention than it has yet received, and whether the works be large or small, the question of their adoption is worth considering.

The requirements of a traction station are not so exacting as those of a large works, nor are the conditions of working so severe as in the case quoted in these notes.

Electric driving is rapidly becoming so universal that the most arduous and unpromising cases for the electrician must be considered. The driving of such a load as a steel rolling mill, and the being able to do it without disturbing such a delicate load as an incandescent lighting circuit, must be considered a point in favour of electric driving.

There must be many cases in which the conditions are as severe, and in showing what a reversible booster has done in his own experience, the writer hopes to help in bringing forward its use and to demonstrate the applicability of the electric motor to any task, however severe, to which mechanical power can be applied.

## AMERICAN VIEWS ON HEATING, IN CONNECTION WITH ELECTRICITY SUPPLY.

The first point that strikes the Britisher landing in New York in mid-winter is the widespread differences which exist in regard to that important item of domestic economy concerned with the heating of offices and houses. Whereas the thrifty Teuton closes all windows, and makes a burnt-offering of a half a score or so of briquettes in a tiled stove (which bears a striking architectural resemblance to the memorials erected in some villages to their inhabitants who fell in the Franco-Prussian war), the Yankee exists in an equally unventilated condition at a temperature of about 80° F., caused by water or steam-heated radiators. Regarded economically, either the American or German methods, when applied to a single house, are thermo-dynamically

superior to that colossally extravagant device, the British fireplace. Reviewing the progress in these two countries, while the German has remained an individualist, the room, rather than the house, being the unit, the American has, in the more closely packed areas, lately shown a tendency to depend upon companies supplying hot water or steam to a number of customers. On the face of it, the heat losses in the mains between the house or store and the station would seem tremendous; yet the fact exists that many American central stations augment their revenues by the sale of live or exhaust steam for heating. The recent convention of the American National Electric Light Association devoted a considerable part of its time to the consideration of the report of a committee on "district heating." The information furnished savours more of the generalities of a presidential address than the report of a body of engineers. Some of these rather wide generalities are, however, not uninteresting. It is suggested that the financial field of such enterprises lies in cities "where steam coal costs from one to two dollars, and where domestic coal runs from four to nine dollars." It is also suggested that where the winter peak load is short and sharp "managers might be warranted in installing some inexpensive, simple non-condensing engines, the exhaust from which would be well utilised for heating purposes; or it might even prove to be best, under proper conditions of load and fuel costs, to install condensing apparatus which would run only during the summer, but which in the heating season would be cut out, the exhaust steam being then used on the heating system."

The following paragraph of the report—which we quote from the account in our namesake and contemporary in New York—serves to indicate the nature of the precise (?) information afforded by the committee:—"The returns we get from steam heating plants indicate that it is safe to figure for ordinary conditions about 0·20 lb. of water per sq. ft. of radiation (varying from 0·05 to 0·50). As all the consumers are not using steam at the same time, particularly if on a meter basis, the load-factor should be no more neglected than in the lighting business." No particulars are given, say, of the actual water metered to the consumer or of its cost. Neither is anything said of the losses in piping. Later on we read that depreciation is estimated at 5 per cent. Considering the short and merry life of most American mechanisms, such a depreciation must either bespeak a manufacturing revolution or a sad miscalculation.

Had this subject been treated economically or thermodynamically, central station engineers in northern towns, whose boiler pressure during the evening peak never gives them any qualms, might have taken an interest in the matter. With the information at present available, it is scarcely of academic interest.

To a smaller degree the same reproach applies to some reports which were presented to the Convention on electric heating. In these much was made of electrically-heated irons in laundries. One member dealt with the question of cost. Within 12 months his company had increased the number of flat-irons connected from a dozen to over 600, "consuming possibly 75 to 90 cents each" *(sic)*. His company had "displaced gas irons in a town where gas is sold at 90 cents a thousand cubic feet, upon a basis of 3 cents for electricity." This apparently involved to the consumers an increased price of from 10 to 25 per cent. extra for the convenience, quickness, and cleanliness of electricity. Supply current for cooking at 4 cents per unit, was found to compare with gas at $1.50 per 1,000 cb. ft. Electricity for heating had been found by this company to be a failure except for the isolated houses of the rich. They regarded favourably curling irons and kindred small apparatus, which paid from 25 to 50 or 100 cents a month to the station, but these needed to be pushed by personal solicitation.

Another member in his report gave particulars of the requirements of different classes of apparatus, and declared the sphere of the radiator to be in the bathroom, where a 2,000-watt radiator would be needed for 15 or 20 minutes. As regards general cooking, electricity had to be sold at 3 cents "to be on a par with good $1 gas." He estimated that regular cooking by a servant will take "a kilowatt per day per meal per person." A few words further on we are given "about 3·33 watts per meal per day per person." "Kilowatt-hours" are presumably meant in each case.

As regards the heating of water electrically in the kitchen boiler for kitchen utilisation, this is regarded as impracticable, but for bath-room purposes, as a substitute for the geyser, such heaters are recommended.

Competition with gas companies on this side of the Atlantic is a keener matter than in the States. The contributions on this subject secured by the Convention do not point to immediate success in domestic spheres. An investigation in England would have evoked fewer generalities and more detailed figures. On generalities alone successful businesses cannot be founded. Perhaps the next Convention will descend to be precise and deal with thermal efficiencies. Ere then some of the exhibitors at Olympia may have something to say on this side of the case.

## THE NATURAL FIELD FOR COAL-GAS.

To that fairly large section of the community—even, be it said, of the engineering community—which does not read the reports of the chairmen's speeches at the meetings of the shareholders in the great railway companies with the same amount or kind of interest which they are able to discover in the latest novel, we suggest that they miss unknowingly the ever-recurring chance of an intellectual treat. Whether the diminished receipts from various sources, which they have had to record too often within the last few years, gives to the chairmen's words the most pessimistic and often with it the most near-sighted tone, or whether the same sad figures are turned by other chairmen with good digestions and clearer heads to the ultimate prophetic advantage of the happily credulous shareholders, the minutes pass pleasantly and profitably as we groan, or stare, or laugh, or meditate, over the newspaper reports. The excuses for the bad year are so ingenious yet so true, or at least half true—the statistics themselves are so interesting as they stand, and lend themselves so obligingly to the whims of the man who never sees a pair of figures but he wants to make another; the correlative and general information that can be distilled from the paragraphs; the prejudices which the broad-minded reader will deride but pity; the good sense that he has the wit to applaud, and the humour, richer unconscious than premeditated, at which he rubs his hands—all combine to make these reports at least as interesting and certainly fuller of living and often sensational facts than the cleverest example of modern fiction.

These thoughts stirred within us once more as the half-yearly report season has just been with us, and, while we have no intention of dissecting any of the speeches delivered at the general meetings in order to excuse our appeal to the intelligent brotherhood of engineers, we desire to draw attention to the speech of Mr. Cosmo O. Bonsor, chairman of the South-Eastern, and to that of Lord Claude J. Hamilton, chairman of the Great Eastern. Both companies have suffered loss through a decreased coal traffic; and the reasons put forward by the speakers have more than a little significance.

Mr. Cosmo Bonsor said: "The mild winter, no doubt, had had something to do with the smaller quantity of coal carried, but what had had still more to do with it, he believed, was that the large gas companies were using more oil than formerly."

Lord Claude Hamilton is reported as follows:—(*Times*, July 29th). "The reduction in the coal traffic was due to the general depression of trade, but it was also occasioned by the growing use of gas stoves in place of open grates burning coal. No fewer than 16,000 of the 22,000 houses in Norwich were fitted with gas stoves last month, and the number was growing at the rate of 80 or 90 every week. It might be taken for granted that these houses would, but for the gas stoves, consume an annual average of three tons of coal each, or a total of 48,000 tons. The loss, therefore, to this company alone in receipts from that source (Norwich) was nearly £10,000. The board understood that plant was being laid down in the company's district for the generation of water-gas, and this again, if it resulted in success, would tend further to diminish their coal traffic to the gas works."

However unsatisfactory the decreased revenue from coal traffic from the causes mentioned above may be to the

directors and proprietors of these railways, there is cause for very different sentiments to be expressed by the rest of the population.

We have not forgotten that the Royal Commissioners on coal supplies stated in their final report that at least half of the 32,000,000 tons of coal estimated to be burned annually on the domestic hearths of Great Britain could be saved by the application of economical heating apparatus, and we rejoice to have proof that the saving is in the act of being made, for that is what Lord Claude Hamilton's words imply. 48,000 tons of coal (we have no desire to criticise his Lordship's figures) will be carried into Norwich alone, less this than last year for household use, and that is put down by implication as a dead loss, although there must be something to put on the other side for increased traffic in gas coal to the gas works. 48,000 tons, however, is the measure which the chairman has taken of the economy to be made annually by exchanging coal fires for gas stoves in 16,000 out of 22,000 houses. The efficiency of the gas stove is that much better than the open fire.

Norwich has a population which is about one five-hundredth of the population of Great Britain, so that an economy of no less than 24 millions of tons of coal per annum would be made by the adoption of gas stoves throughout our country in the same proportion as in Norwich. Allowing 50 per cent. for an exaggeration in his Lordship's estimate of 3 tons saved per house, and for an increased consumption in the gas works, we may say with some faith that 12 millions of tons are being wasted for want of gas stoves. While the consumer is economising, the producer is not becoming more extravagant, and it is not impossible that gas works will supply the increased demand on the same amount of coal as before. It is to that end that "the large gas companies are using more oil than formerly," and so reducing the South-Eastern's coal traffic.

How many times has it been printed, and how many thousand times has it passed from lip to lip that the advent and growth of electricity in the region of lighting has not been antagonistic to the continued prosperity of the gas undertakings? Statistics, verified by both sides, which proved that the rate of increase of gas consumption actually tends to rise whenever electricity enters the field with it have been published and republished. The reasons for this seeming anomaly are known, and one of them is apparent from what has preceded these words. Gas as an illuminating medium has become less popular than electricity, and will become still more unpopular, until in the end it ceases to be used for lighting altogether, and this, notwithstanding the ever more successful efforts which are being made to impoverish the gas for use with incandescent burners in order to bring it down to a price at which it will compete again with electricity. "Poor" gas was not made in the first place for illuminating, but for heating, and everything possible ought to be done to help on its development by improvements in legislation as well as in methods. The transition period between the use of full and poor gas will be marked possibly by a certain degree of annoyance and discomfort to persons who still use the bat's-wing burner, but they will have to fall into line with the more advanced section of the community and discard the old for the new so long as they remain users of gas for lighting.

The time is not yet when electricity will offer any serious competition to gas for heating purposes, and until that time arrives at least, the consumption of gas of some sort, but almost undoubtedly of the nature of water-gas, will be affected only for good by the advance of electricity for domestic, factory and other uses.

It is to the increase in gas consumption that we have to look even more than we look to electricity for the gradual dissipation and eventual disappearance of the pall of smoke which overcasts our once fair land, for it is from gas that electricity itself will be transmuted, and no one with the least fragment of prophetic fire within him can look at the enormous gas-making industry in this country without foreseeing the day when the makers of gas and electricity will go hand in hand towards the golden apple of efficiency. In that day shall our children—hardly we ourselves—see the generation of electricity at the gasworks, and the transmission of it to distances to which the old-time gaspipes were unsuited, while they who desire to generate their own electricity will tap the gas main for the gas engines as well as for the whole of the heating and cooking apparatus.

The present aspect of affairs, the snarling teeth of the gasmen facing the bared knives of the electrically-inclined, is not an aspect over which the economist need shed his tears, for the angry teeth will keep the owners of the knives alert to seize new opportunites, and to work to windward and sunward of their enemy, while the flashing blades will make a stand or a backward step a dangerous act for the opponents of the harnessed lightning, all of which will make for the good of the consumer. "Hock! the conshoomer!" as Dooley says.

## ECONOMY OF LARGE UNITS.

One of our contemporaries recently published an article in which larger units are demanded. It is probably a dozen years since we pointed out that the practice of using a multiplicity of small engines, in place of fewer large ones was a mistake. The trouble with electrical practice arose, of course, from the experimental stage of electrical development. The established steam-engine makers fought shy of electrical work, and a new set of makers came into being who fitted their engines to the dynamos of the day, and the result of this was that an electrical station of the older type consisted of a long vista of little engines, and some designers have never shaken themselves free from the early practice. That practice was the best that could be contrived with the available electrical plant of the time, and standard types of engine naturally came into vogue as soon as electrical generators became of a size to warrant this. Small engines cannot be so economical as large ones.

There is to-day a tendency to consider that the economy of steam power on a steamer or in a cotton mill, is due to the one large engine which takes the place of many small ones in the electrical station. But while this is true in great part, it is doubtful whether the fuel economy of an electrical driving engine can equal that of the engine of a ship or a factory even when of equal size. Something depends upon the load factor, and no electrical station has a load factor equal to that of a steamship or of a cotton mill. But it may at least be said that there can be no justification for small engines when their full load steam consumption is greater than the partial load consumption of larger engines, nor can there be any reason for putting down small sets when the minimum load of the station cannot by met except by running two or three of these small sets at once. Apart from the unavoidable necessity of small sets at one time, the early steam engineering was bad in other respects. Not satisfied with a dozen engines where two or three would have been desirable, each small engine would have two ways by which steam could reach it, either by ring main or by branch pipes.

One possible advantage of the small engine was that if it did fail it could be quickly replaced by another one, and there was really no need for duplicate steam pipes. One wonders who invented the idea. It was advocated by those responsible for many of our English stations, as though no single steam pipe steamboat had ever left English waters; as though cotton mills had been in the habit of shutting down because of steam pipe failures; as though steel pipes had not come into use to enable piping to be constructed and erected with the minimum risk of failure. Excessive duplication has been attributed to the opinion of the electrical engineer that his work was faulty; but the real cause of excessive duplication was mere blind following of fashion. A sad waste of capital was made, and a worse waste of steam and fuel.

## BUSINESS NOTES.

**Consular Notes.**—Mexico.—Manufacturing in Mexico is as yet in its infancy, but it is bound to grow very rapidly within the next few years. It is commonly asserted, says the United States Consul-General at Mexico City, that the principal obstacle to manufacturing in Mexico is the lack of fuel, but this is actually not so great an obstacle as it appears. The people are just beginning to wake up to the vast unused water-power of the country, which, fortunately enough, exists in great abundance near the large centres of population. There are but few very large streams in the Republic, but, owing to the mountainous nature of the greater part of its area, there is an abundance of small streams which, owing to their rapid fall, offer a great amount of power to be utilised. Certain obstacles, however, have to be overcome in using this water-power. One special fault is that many of the streams have dry beds for about six months of the year. The problem to be solved in such cases is how to profitably use the water power which can be derived from such streams during the rainy season when they are full? In some cases where power from streams that are dry during part of the year is now being utilised to generate electric power for lighting, &c., coal

or other fuel is used during the dry season. The exclusive use of coal for generating steam to run the plants would render the cost of their operation prohibitive to profits, but by using the water power for some six months of the year, profits can be made. Another great obstacle, similar to the one which is encountered in some Southern States of the United States is that of vegetable growth, which at the present time greatly impedes the use of water from streams infested by it. This obstacle has, however, been overcome in the United States, and there is no reason why it should not be overcome in Mexico.

Of the great abundance of water power with which the country is supplied, it is estimated that not more than 250,000 H.P. is being utilised, or is in the course of development at the present time.

The potential horse-power has never been estimated with any degree of accuracy. According to an article which has appeared in the *Mexican Herald* recently, the average cost of power derived from steam in Mexico City is between $190 and $225, Mexican currency, or about £20 sterling per horse-power per annum. The Mexican Light and Power Co., a Canadian concern, which is installing an electric power plant at Necaxa, in the State of Puebla, proposes to sell electric power in Mexico City at $120 to $125 (Mexican), or £11 sterling, per horse-power per year. The company proposes to develop about 100,000 H.P., of which 80,000 H.P. will be transmitted to Mexico City. At present, according to the same authority, the total horse-power derived from steam plants in the city is less than 32,000.

The Guanajuato Electric Light and Power Co., whose power house is situated on the Duero River, in the State of Michoacan, has a capacity of about 8,000 H.P., 4,000 of which has already been developed. It is transmitting its power over an aerial wire to Guanajuato, where it is at present being used for lighting, mining and other purposes. This company purposes increasing its horse-power very greatly in the near future, and furnishing power to a number of cities in that part of Mexico.

The Falls of Juanacatlan, near Guadalajara, furnish several thousand horse-power, which is transmitted as electrical power by means of aerial lines to Guadalajara, where it is used for lighting and commercial purposes. This section of Mexico has an immense potential water-power which will, no doubt, be used in the near future for the generation of electrical power.

The San Ildefonso Co., of Mexico City, generates electrical power from water power near the city in the rainy season, and uses steam power in the dry season. Another large undertaking in prospect is that of the Mexican Railway, which purposes utilising water from the Atoyac River to generate electrical power for use over that part of its line which lies between Orizaba and Esperanz, where the steep grade makes steam as motor power extremely expensive. Many cotton mills and electrical plants in the region of Orizaba are now operated by water power. The Teziutlan Copper Co. has a plant at Teziutlan, in the State of Puebla, for the generation of electrical power.

Recently a great many concessions have been granted by the department of public works of the Mexican Government to companies and individuals for the utilisation of water from the streams of the Republic for the generation of power. The Government is fully awake to the desirability of having the water power of the country fully developed, and it offers very liberal concessions to *bond fide* companies or individuals who desire to utilise it. Herein lies a partial solution of the fuel problem of Mexico. When its water power has been fully developed, manufacturing industries can reasonably be expected to flourish.

**Receiver Appointed.**—Mr. W. B. Peat, 3, Lothbury, E.C., has been appointed by the Court, receiver and manager of Benham & Froud, Ltd., on behalf of the debenture-holders. He is carrying on the business under the sanction of the Court, and Mr. H. A. Benham will sign orders on his behalf.

**Belgium.**—The balance-sheet of La Societe de la Fabrique Belge de Crayons Electriques, of Liége, for the last financial year, shows a loss of £1,172.

**Stirling Boiler Contracts.**—The Stirling Boiler Co., Ltd., of Motherwell, have recently received the following orders:—

For the Indian State Railways.—Repeat order for one marine type boiler to evaporate 10,000 lb. of water per hour, with chain-grate stokers, motor, fan, chimney, pumps, piping, &c.

For the Cawnpore Tramways.—Three marine type boilers, each to evaporate 6,500 lb. of water per hour, complete with superheater and chain-grate stoker.

For the Borough of Leigh Electricity Works.—One boiler to evaporate 13,600 lb. of water per hour, fitted with superheater and Hodgkinson stokers.

**Considering the Employés.**—Messrs. Joseph Crosfield & Sons, Ltd., of Quay Bank Works, Warrington, in announcing that they have just been favoured with the Royal Warrant as manufacturers by special appointment to his Majesty the King, have placed in our hands another copy of their interesting works pamphlet, in which they give full particulars, with appropriate photographs, of the various measures adopted by them at their soap and chemical works, for making the lives of their employés brighter and more contented by providing for them numerous organisations for recreation, entertainment and self-improvement. As we think we said when a former edition of the pamphlet appeared, other manufacturers might with advantage study the efforts of Messrs. Crosfield. Indeed, we understand that various deputations from other firms have visited the works, and some have adopted certain ideas, the working out of which they were able to inquire into at Warrington.

**Milan International Exhibition, 1906.**—At a meeting of the Milan International Exhibition Committee, constituted from the Associated Chambers of Commerce, the London Chamber of Commerce, the Italian Chamber of Commerce in London, and other bodies, it was reported that the British Government had intimated that a grant of £10,000 would be made in aid of a British Section at the Exhibition. Provisional arrangements were also made for the purpose of communicating with the local authorities of the exhibition at Milan as to space for British exhibitors, and also for ascertaining provisionally what British exhibits may be expected. Delegation from the Committee consisting of Lord Brassey, Sir Albert Rollit, M.P., and Mr. Arthur Serena will proceed to Milan to confer with the local exhibition authorities there, and to make provisional arrangements on behalf of the British Section. Possible exhibitors are requested to communicate with the secretaries of the Committee for the Milan Exhibition at the London Chamber of Commerce, by whom information will be afforded. It may be added that this is the first International Exhibition held in Italy, and Milan is the industrial capital of the country. It is being organised under the auspices of the Italian Government, the King of Italy being a patron. From all that can be gathered the success of the exhibition is assured, the Governments of France, Germany, Austria, the United States, and those of other countries, having already decided to be officially represented.

**Motor-Tower Wagons.**—The Mo-Car Syndicate, Ltd., of Paisley, have lately supplied a 12-H.P. petrol motor-tower wagon to the Glasgow Corporation for use in connection with the electric tramways.

**Electromobile Runs in France.**—Following the example of Messrs. Vedrine, the Krieger Co. are this week subjecting two of their electrical motor vehicles—a landau and a coupé—to a long-distance run from Paris to Deauville. A stop will be made at Evreux *en route* to recharge the batteries.

**Mica in the Transvaal.**—"Mica has been receiving increased attention of late in the Transvaal. On account of the vast strides being made in electrically-driven machinery, there has been a corresponding increase in the demand for sheet mica for insulating purposes, at prices ranging from 2s. to 15s. per lb., according to size. The many uses to which it is applied are well known. Local enterprise has been developing the mica deposits in Zoutpansberg with every promise of success. The quality of the mica has been declared by London authorities on the mineral to be true Muscovite, and equal in every way to the best Indian product. A syndicate has been formed, with a capital of £30,000, of which £4,000 will be held in reserve, for the purpose of acquiring 1,000 mica claims situated in the district of Pietersburg (Division of Leydsdorp), Transvaal, to work and prepare the mica for shipment, and to dispose of same in London, New York, and Continental markets, besides supplying local requirements."—*South Africa.*

**Annual Outing.**—The employés of Messrs. Frank Suter & Co., Ltd., went for their annual outing on Saturday last. The party went by train from Waterloo to Shepperton, and hence by brakes to The Cricketers, at Chertsey, where dinner was served. Mr. Frank Suter presided. The great attractions of the river rendered a set programme of sports unnecessary.

**Electric Printing Machinery.**—Messrs. J. H. Holmes & Co. have recently booked an order for the equipment, on the Holmes-Clatworthy system, of the rotary presses to be employed in producing the *Tribune*, the new Liberal paper.

**Electric Plant in Mines in India.**—The following note has come to hand regarding the paragraph quoted in our issue of August 18th, which reached us from an Indian correspondent:—

"With reference to the recent paragraphs in your paper on the above subject, I presume your correspondent refers to electric power for *haulage* purposes, as I know that the Equitable Coal Co., of Burrakur, installed plant for coal-cutting and lighting as far back as 1896, and also that the Borrea Coal Co. followed suit a year or so afterwards. I believe also that there are other collieries in India already using electric coal-cutting machines.

"H. F. D. Jacob.

"Brixton, *August 26th*, 1905."

**Advance in Prices in Germany.**—It is announced that a number of firms in Germany have just decided to make an increase of 10 per cent. in prices, apparently only for the inland market. The works concerned are the Allgemiene Electricity Co., the Siemens-Schuckert Works Co., the Felten & Guilleaume-Lahmeyer Co., Brown, Boveri & Co., the Bergmann Electricity Works Co., the Berlin Maschinenbau Actien Gesellschaft vorm. L. Schwartzkopff, the E. H. Geist Electricity Co., the Carlsruhe Electrical Industry Co., and the Saxon Light and Power Co. The increase, which relates to the prices of generators, motors, transformers, and regulating apparatus, and which has been brought into operation at once, is explained by the general increase in the cost of raw materials and wages, and the disproportion thereby produced between the cost of manufacture and the prices of sale.

**New Continuous-Current Motors and Generators.**—The British Thomson-Houston Co., of Rugby, has recently introduced a new line of continuous-current motors and generators, in connection with which the firm is issuing an illustrated descriptive pamphlet, giving all particulars. The machines are of the "D B" and "M P" types, and are built in the following capacities:—"D B" motors, 25 to 70 H.P; generators, 20 to 50 KW.

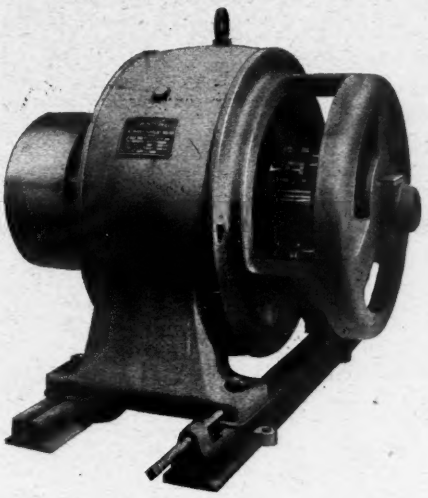


Fig. 1.—"D B" Type Motor.

"M P" motors, 70 to 100 H.P.; generators, 50 to 100 KW. The former class of machine is of the "enclosed protected" type, while the latter are supplied in "open" type only.

In the D B machines the bearings are supported in end shields, which can be turned round through suitable angles to permit of the machines being fixed to either floor or ceiling.

In the M P machines the bearings and frame are supported on a common bedplate, the bearings being of the self-aligning type. In both classes of machine the armature is drum-wound, and the

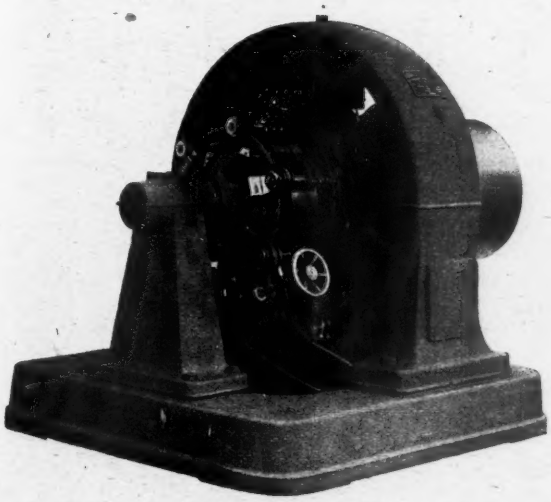


Fig. 2.—"M P" Type Motor.

brush gear, provided with carbon brushes, is of a substantial and convenient character for facilitating adjustment or renewals. All parts of these machines are made to gauge, and duplicate parts can be obtained at any time from the makers.

Both motors and generators are built for a range of pressures and speeds; they embody the most recent practice in this class of apparatus, including ample ventilation and low temperature rise, sparkless commutation from no-load to 10 per cent. over-load without brush adjustment, and they will carry over-loads of 25 per cent. for one hour, or of 50 per cent. momentarily without injurious heating or sparking. We illustrate in figs. 1 and 2, the respective types of generator.

**Book Notices.**—*Mechanical Appliances.* By Gardner D. Hiscox. London: Archibald Constable & Co., Ltd. 1905. 12s. 6d. net. This book, as stated, is simply a well illustrated dictionary of mechanical movements, and its arrival at a tenth edition may be taken as some evidence of its usefulness and popularity. It is a machine designer's book, a book to look through when some means of accomplishing an end is to be found mechanically. The author has included perpetual motion devices rather to point a moral than to adorn a tale, and he has not confined his collection of appliances to moving combinations. He includes the various forms of steel springs, steam boilers, fuel oil burners, boiler feeders, types of steam engine, and indeed, an enormous array of machinery, appliances and details, nearly 1,000 in number. The most appealing of the perpetual motion devices is that of two disks on shafts inclined in such a way as to bring the disks nearer together at one side than at the other. Hence the water rises by capillarity high up on one side, and by its weight is supposed to pull down the disks at this side, so producing rotation. If we accept the capillary effect, why do not the disks rotate? Explanations of the why? are not, however, tendered. May it not be suggested that the viscosity or tension of the water which promotes the capillarity, is great enough to hold the disks against rotation. We all are bound to be sure without trial that they will stand still, and it is this stupid attitude of engineers who won't go to the trouble of building perpetual motion machines that aggravates the poor inventors of the appliances. There appear very few of the mechanical movements that were once to be found in collections of this sort. Thus the clock escapement is nearly obliterated from the book, and so are wheel trains, but there are rotary engines, gasoline motors, fire extinguishers, and a host of unexpected appliances, and even gas producers. The book is, indeed, sufficient to give ideas on almost anything.

*British Standard Specifications and Tables for Telegraph Material.* Interim Report issued by the Engineering Standards Committee. London: Crosby Lockwood & Son. 10s. 6d. net.—The subject of telegraph material from a standard point of view is a most difficult one to tackle, as there is not only the greatly varying use due to local conditions, but also the constant change of patterns due to improvements and to changing requirements. That this is recognised by the Committee is evident, as the material standardised, although by no means unimportant in amount, forms only a mere fragment of what is required in actual practice. It has not been considered desirable to issue a specification for copper wire. Copper is itself (says the Committee in the preface) so costly that manufacturers are scarcely likely to stock it in large quantities, more especially on account of the considerable variation in the requirements of different users. It was therefore decided not to go further in the direction of standardisation than the preparation of tables furnishing data based on the standards given in Report No. 7 (British Standard Tables of Copper Conductors and Thicknesses of Dielectrics). No attempt has been made to standardise submarine or underground cables, as it was deemed inadvisable to deal with these questions in the present state of the industry. It has, moreover, not been thought necessary to touch upon the question of standardising telegraphic or telephonic apparatus, or even parts of such apparatus, as the Sub-Committee felt that no useful purpose would thereby be served. The actual standards fixed upon is shown by the following list of contents:—"Standards for Copper Conductors," "Standard Sizes of Hard-drawn Copper Wire," "Standard Sizes of Annealed Copper Wire"; Table No. 1, Weights and Resistances, per Statute Mile; Table No. 2, Weights and Resistances, per 1,000 yards. Specifications for:—No. 1, Iron Wire for Conducting on Live Wire; No. 2, Iron Wire (Stranded) for Mechanical Purposes; No. 3, Iron Wire for Binding; No. 4, Arm-Bolts, Nuts and Washers; No. 5, Stay Swivels; No. 6, Truss and Brace Rods and Truss-tie, Tie and Brace Bolts; No. 7, Stay Rods and Tighteners; No. 8, Insulator Spindles; No. 9, Terminal Insulator Spindles; No. 10, Single Cup-holders "J"; No. 11, Double Cup-holders "J"; No. 12, Double Cup-holders; tensile test-pieces. The standard sizes of copper wire for overhead telegraphs and telephones vary from 70 to 800 lb. weight per mile, and the sizes of commercial annealed copper conductors from No. 7 to No. 50, S.W.G. The latter table is a most valuable one, though if it had been extended so as to cover all the general data given in the classical "Glover's table," it would have been of still greater value; but such an extension would, doubtless, be beyond the functions of the Committee. In the specifications generally, there is a complete absence of conditions which might be harassing to a contractor, whilst the conditions laid down are ample for ensuring good material.

"The Universal Directory of Railway Officials." London: The Directory Publishing Co., Ltd. Price 10s.—The 1905 edition (eleventh year of publication) of this very useful annual has come to hand, and naturally several additions have been made. It has been completely revised and the type entirely re-set. Not only is the book a directory of the official *personnel* of all the railways of the globe, but information as to rolling stock, mileage, &c., is given, and all tramways in the United Kingdom worked by electrical and mechanical power are similarly included. All the information given has been compiled from official sources under the direction of Mr. S. R. Blundstone, editor of *The Railway Engineer*.

**Electric Power in Steel Works.**—In the annual report of the Steel Co. of Scotland, Ltd., it is stated that the amount expended this year on additions to and reconstruction of plant, namely, £33,009, was higher than in the previous year. The extra expenditure was due to the reconstruction of part of a mill roof and a new electric crane at Blochairn, also to the extension of electric power plant at Hallside.

**Improved Trestles.**—Mr. J. H. Heathman, of Parson's Green, is continually exercising his ingenuity in meeting the needs of electrical wiremen and lamp attendants. He is now introducing an improvement which he has patented for making ladders convertible into long or short steps and trestles. This and his numerous other specialities can be viewed by electrical engineers at his factory at Parson's Green.

(*Continued on page* 347.)

## THE YORKSHIRE ELECTRIC POWER SCHEME.

Last week our special pages were devoted to a description of the initial work in connection with the opening of a leading Scottish power supply system. This week, through the courtesy of Mr. W. B. Woodhouse, the chief engineer, we are enabled to give our readers some details of a much larger scheme at present commencing operations, namely, that of the Yorkshire Electric Power Co., to which Mr. H. F. Parshall is the consulting engineer. The progress of this scheme has since its promotion been frequently noted in these columns; it embraces a most important industrial area (a map of which is shown on page 345), comprising some 1,800 square miles in South and West Yorkshire, and containing 18 boroughs, 118 urban, and 21 rural districts. The power users in the area, which the company seeks to supply, comprise local authorities (bulk supply), railways, tramways, and canals, textile factories, collieries, and engineering works, &c., and the estimated power in use amounts to some 3,000,000 H.P., principally supplied by small steam units of doubtful efficiency. The company as well as being authorised to supply local authorities in bulk, has power to make other agreements with them. Where the local authority holds a provisional order for the district, the company may not supply in that district without its consent.

A number of local authorities have realised that it is greatly to the advantage of the district to let the Power Co. supply all large consumers direct, and they have arranged to take a bulk supply for distribution for lighting and small power users.

Owing to its size the area is divided into several distribution areas, of which the first, supplied from the Thornhill generating station, has now commenced operations.

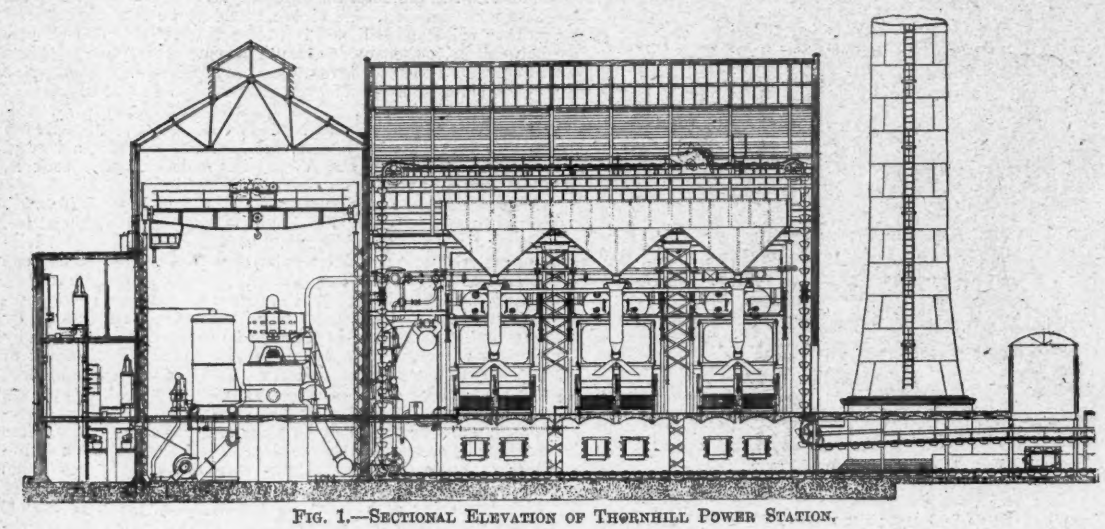


Fig. 1.—Sectional Elevation of Thornhill Power Station.

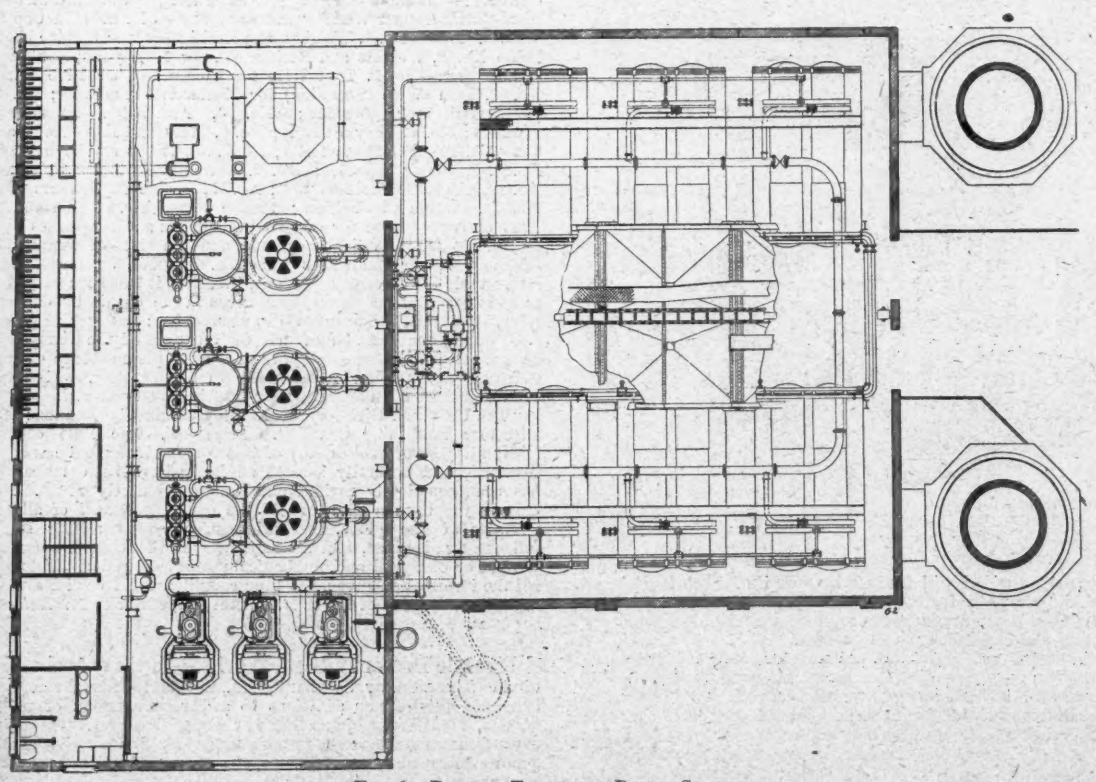


Fig. 2.—Plan of Thornhill Power Station.

This power station is situated between the L. & N.W. Railway Co.'s Ravensthorpe station and the River Calder, an extremely favourable position in regard to fuel and water supply, and, moreover, in the heart of a manufacturing and colliery district, a fact which is not realised from a glance at fig. 3 of the power station.

The station, of which a plan and elevation are given in

figs. 1 and 2, is a steel and brick structure, divided into engine and boiler houses, measuring respectively 100 ft. × 50 ft. and 70 ft. × 80 ft.

Extensions will be made as required by adding to the present station, which is in itself two complete "unit" stations,

Fig. 3.—Thornhill Power Station.

similar "units" until a total capacity of some 60,000 H.P. is reached.

The fuel supply to the station can be obtained either by road, rail or river; by road, coal is delivered to a hopper outside the boiler house, from which, by means of a bucket conveyor, it is raised to the bunkers; a railway siding, not yet constructed, will feed the same conveyor, which has a capacity of 25 tons of coal per hour, and is driven by a B.T.H. D.C. motor from the 220-volt station power circuit.

Steel coal bunkers are arranged over the boiler house, a view of which is given in fig. 6, and from these coal is delivered through automatic measuring shoots to each boiler. Provision is made for six boilers, of which four are already installed. These are of the Babcock & Wilcox type, and are each capable of evaporating 20,000 lb. of water per hour at a temperature of 60° F., to steam at a pressure of 160 lb. per sq. in., and with a superheat of 150° F.

Each boiler has a heating surface of 5,730 sq. ft., and a grate area of 100 sq. ft., the grates being of the "chain" type, with stoker gear driven by D.C. electric motors.

The ashes fall by gravity into the basement, and are delivered into small tip trucks running on a 2-ft. gauge railway, which will eventually facilitate their being barged away.

A main flue is arranged under each of the two rows of boilers, leading direct into two brick-lined steel chimneys, 150 ft. high and 10 ft. diameter, and no economisers are provided.

The steam piping is arranged in the form of a 12-in. ring main, with 8-in. branches to the several turbines: the valves are of the "sluice" type. Both the steam and feed-water piping is designed so that one-half of the boiler house can be completely isolated from the other.

At the end of the boiler house are situated two compound Hall feed-pumps, each of 8,000 gallons per hour capacity, and a feed-water tank overhead; these feed-pumps are the only auxiliaries which are not electrically-driven.

Two hotwells are situated immediately below the pumps in the basement, and receive the discharge from the condensers, the make-up feed-water being drawn from the public supply.

The engine house is designed to contain generating plant of 8,450 KW. capacity. Two B.T.H. Curtis turbo-alternators, each of 2,000 KW., are already installed, and a third is being erected.

Each turbine unit runs at a speed of 1,000 r.p.m., and is controlled by a centrifugal governor; also it can be electrically controlled from the main switchboard.

The Curtis turbine was dealt with in detail in the Electrical Review of February 26th, 1904, and an illustrated description appeared in our issue of July 7th last. The vertical shaft and all the rotating parts are supported by a hydraulic footstep bearing, water at a pressure of 400 lb. per sq. in. being supplied to the latter from a Berry hydraulic accumulator, in connection with which there are installed two three-throw force pumps, gear driven from 7·5 H.P. B.T.H. shunt-wound motors, and the turbine shaft floats on a film of water. A view of the three-throw pumps is given in fig. 10. The top and centre bearings of the turbine are lubricated on the gravity system, with oil at a pressure of 10 lb. per sq. in., pumped up by means of small force pumps in the basement, which are driven from the accumulator pumps above; the oil pumps draw oil from a settling tank in the basement, forcing it into a tank at the top of the engine house, from which it gravitates back again through the bearings.

A separate vertical surface condenser, with air and circulating pumps, are provided to each turbine unit. The air pumps are of the Edwards type, three-throw, and run at 160 r.p.m.; they were supplied by the Mirrlees Watson Co., and are direct-coupled to a 15-H.P. B.T.H. compound-wound motor.

The circulating pumps are of the Gwynne centrifugal type, direct-driven from 4-H.P. shunt-wound motors, with a speed of 645 r.p.m., and are installed in the basement: each is rated to lift 160,000 gallons per hour from the river, against a head of 28 ft.

The circulating water discharge pipe being submerged at its river end, the siphon action of the system is taken advan-

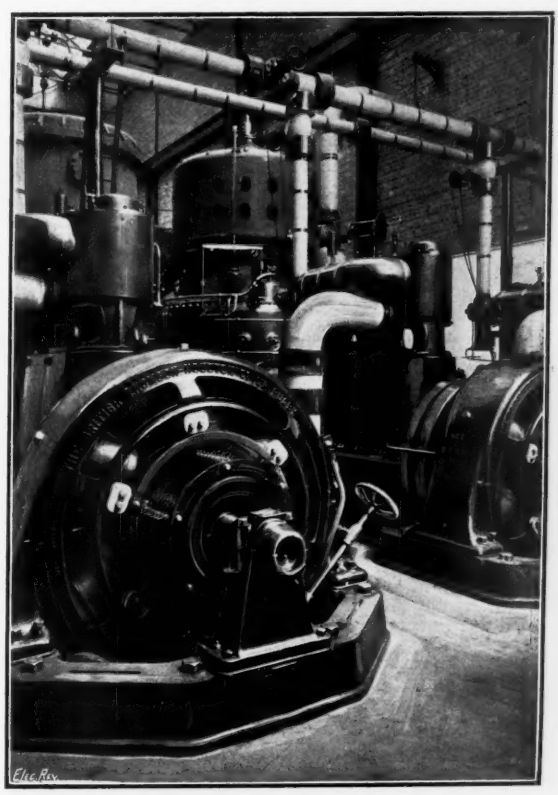


Fig. 4.—Corner of Engine Room.

tage of, with a view to increased economy in pumping: this action is maintained by means of a motor-driven dry-air pump, which draws the air from the pipes and condensers.

As an alternative to condensing, the turbines can exhaust into an atmospheric exhaust pipe, terminating in a vertical discharge pipe at the side of the engine room.

Proportionately large condensing plant has been provided with a view to obtaining the high vacuum necessary for the

economical operation of steam turbines, and the results obtained so far, point to an extremely low steam consumption.

The alternators are of the three-phase revolving field type and generate at a pressure of 10,000 volts, the frequency being 50.

For the excitation of these machines, three Allen-B.T.H. 220 B.H.P. exciters are provided, running at a speed of 420 r.p.m.

The generators are six-polar, 220-volt, 150 KW. compound-wound machines, and in addition to supplying the excitation they operate the station motors, including the switchgear motors.

Views of the turbine-generators and exciters are given in figs. 4, 7 and 9.

A 25-ton electrically-driven travelling crane spans the engine room; it is driven by three B.T.H. motors, one for each motion.

The main switchgear is installed on three floors, at one side of the engine house, and is of fire-proof construction.

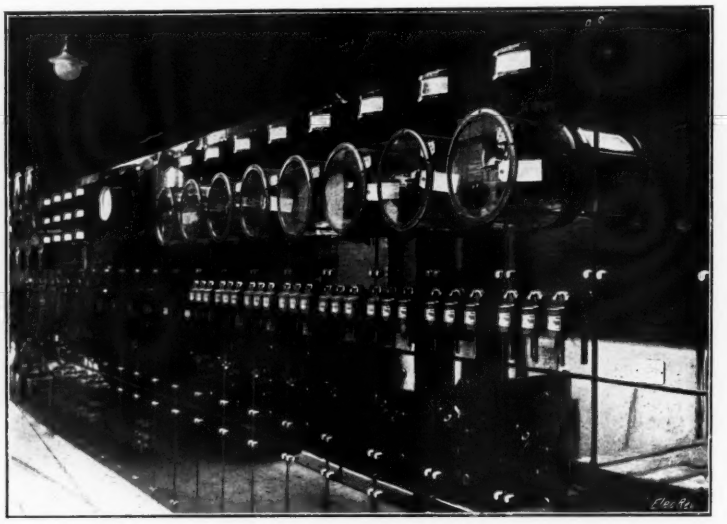


Fig. 5.—Main Switchboard: H.T. Feeder Panels.

Each of the H.T. generator panels is equipped with a horizontal pattern voltmeter, power factor indicator and ammeter; a field rheostat, an operating switch for the H.T. generator oil switch, a turbine speed regulating switch, and a field switch; the H.T. feeder panels are each equipped with an ammeter, polyphase watt-hour-meter, automatic cut-out and an operating switch for the H.T. feeder oil switch; red and green lights are also provided for indicating the condition of the feeders.

The small operating switches on the feeder and generator panels, control through 220-volt D.C. circuits, the B.T.H. motor operated 10,000-volt oil switches, situated in brick chambers, in the case of the feeders, behind the main switchboard, and in the case of the generator oil switches on the floor beneath. The arrangement of the switchgear will be apparent from the sectional elevation of the station,

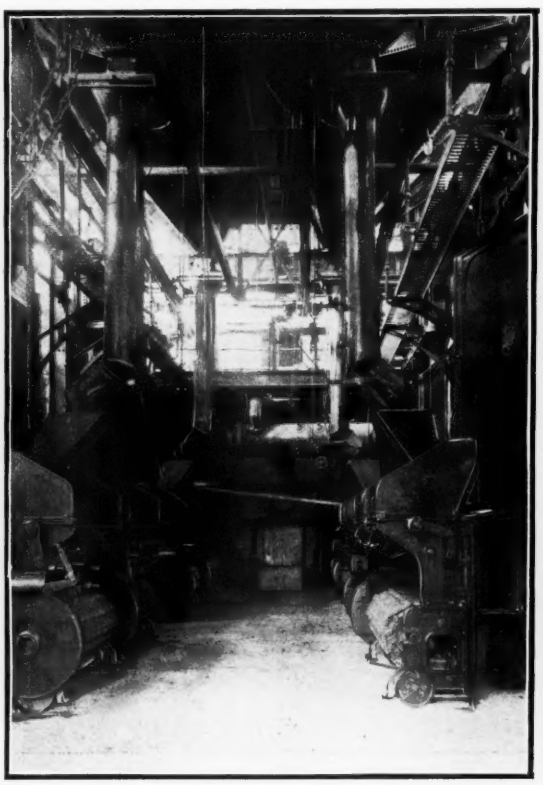


Fig. 6.—View of Boiler House.

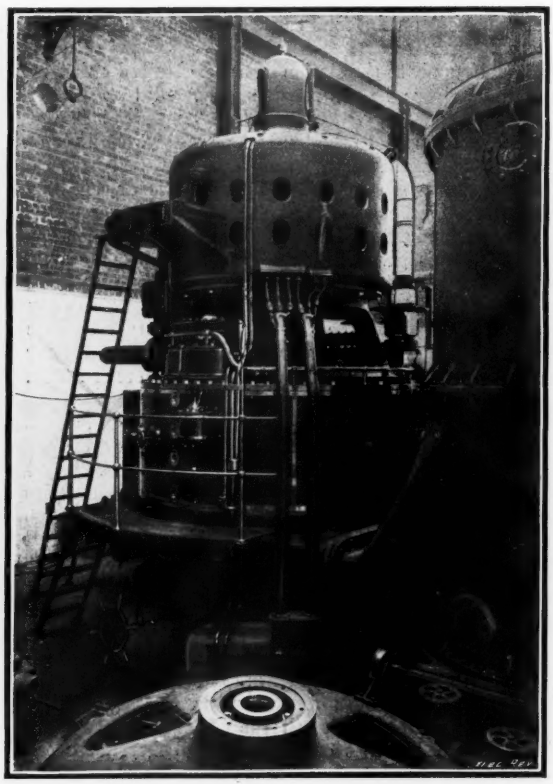


Fig. 7.—2,000-KW. B.T.H.-Curtis Turbo-Generator.

It is of British Thomson-Houston standard construction and provides for remote control of all H.T. switches. The operating switchboard is situated on a gallery, it includes four generator and eight feeder panels for controlling the 10,000-volt three-phase supply, also three exciter panels and two other panels devoted to local power and lighting circuits.

Fig. 1, and views of the main switchboard, auxiliary and feeder ends are shown in figs. 8 and 5, respectively.

No high-pressure current whatever is brought to the front of the main switchboard, the instruments and switchgear being operated by, and controlling only, low-pressure current, and, moreover, the switching arrangements are notable for their extreme simplicity; the protective devices

are fitted in the power station only, and such complications as time limit and reverse current relays have been avoided.

The 10,000-volt transmission mains are in duplicate, and were supplied and laid by Messrs. Callender's Cable and Construction Co., Ltd. These are laid solid in wooden troughs, protected by double boards on the top, the boards being separated by a layer of sifted earth.

The cables are three-core paper-insulated lead-sheathed and steel-armoured, and were tested to 30,000 volts before laying.

At present a trunk main extends from Thornhill to Pudsey, and sub-stations are in operation at Thornhill, Mirfield, Gomersal and Pudsey, while others are in course of erection at Birstall, Soothill and Liversedge.

The sub-stations, of course, differ in design according to the class of work for which they are intended, but as a rule, they contain only static machinery, the H.T. current being transformed down to 2,000 volts for distribution within a radius of 2 miles, for power purposes—in the form of three-phase current—or for lighting as single-phase current, a further transformation taking place where, and as desired, by the consumer.

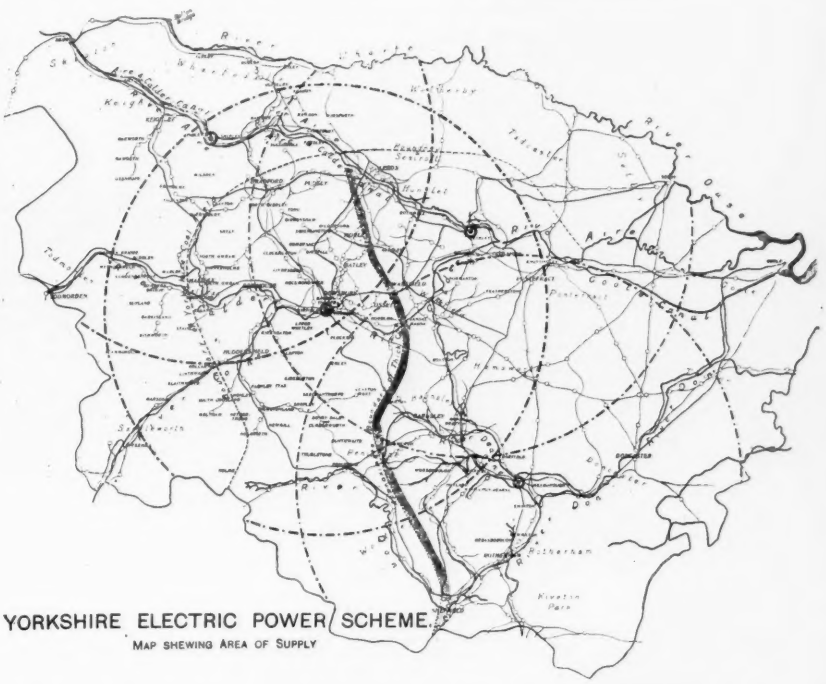
The Mirfield sub-station plant, which is of B.T.H. standard design, may be taken as typical of the others; it comprises an

Fig. 8.—Main Switchboard: D.C. Panels.

operating switchboard behind which will be arranged a bank of four 100-KW. oil-cooled three-phase transformers having a ratio 10,000/2,000 volts, the H.T. side being delta connected, and the L.T. side star connected with earthed neutral.

Behind the transformers are arranged, in Empire stone cells, the 10,000-volt three-phase switchgear, operated mechanically from the switchboard.

The sub-station is interposed on a trunk main; duplicate incoming H.T. feeders, feed separately the two sections of the H.T. bus-bars, through isolating knife switches, and lead out again through similar isolating switches, the H.T. bus-bars being divided by sectional switches.



YORKSHIRE ELECTRIC POWER SCHEME.
Map shewing Area of Supply

From the H.T. bus-bars, energy passes through oil switches to the transformers, and from the L.T. side of the latter, through 2,000-volt oil switches to the bus-bars of the main switchboard. The latter and the 2,000-volt bus-bars are also arranged as two distinct portions, connected at will by sectional switches, one portion being reserved for the company's three-phase supply for power purposes and the other controlling the single-phase lighting feeders supplying the Mirfield U.D.C.'s area.

The feeder panels in either board are equipped with an ammeter, watt-hour-meter, and an automatic circuit-breaker:

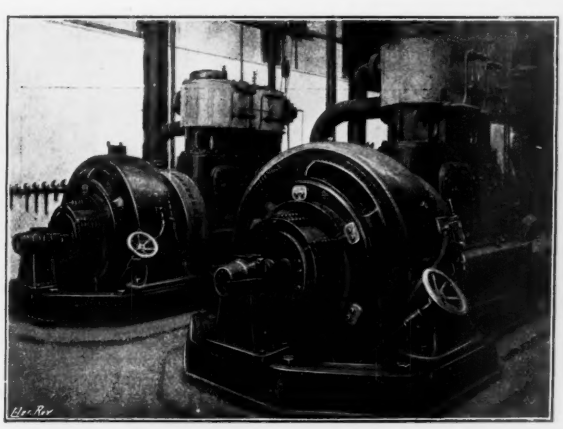


Fig. 9.—View of Allen-B.T.H. Exciters.

a transformer operating panel is provided to each board (two transformers only being erected at present), the equipment including the handles for operating E.H.T. transformer oil switches and three-phase automatic circuit-breakers.

A static potential indicator is attached to each section of the H.T. bus-bars, mounted over the cells at the back of the station, and suitable static dischargers are provided in connection with the H.T. gear both at the sub-stations and power station.

Outside the sub-station separate manholes are provided for the company's and U.D.C.'s mains.

The Liversedge, Birstall and Gomersal sub-stations will follow similar constructional lines to the above: the Pudsey sub-station, however, is designed to give a continuous current supply to a three-wire L.T. network on the lighting side, and motor-generators are installed for that purpose.

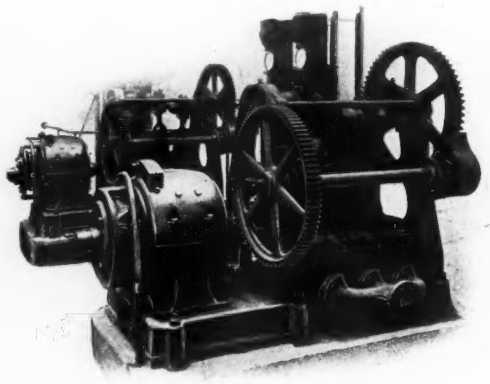


Fig. 10.—Motor-driven Accumulator Pumps.

A large load is anticipated from collieries, of which there are 174 within a radius of eight miles from the present power station, and it is satisfactory to note that many local colliery proprietors are negotiating with a view to adopting electricity in connection with their work.

By means of rotary transforming plant at the power station and an overhead transmission, the company is now supplying the Calder Pit of the Mirfield Coal Co., for coal-cutting, pumping, and hauling.

The company has a special tariff for supply to collieries, or to any consumer who is prepared to take a limited supply, *i.e.*, to any consumer who is prepared to guarantee that a certain percentage of his consumption shall be at night-time, and that his maximum demand will be reduced between the hours of 4 and 8 p.m., so as not to interfere with the lighting load. The diversity factor of the company's consumption will, therefore, be very large, and the load factor on the station correspondingly high.

In conclusion, we wish to acknowledge our indebtedness to Mr. W. B. Woodhouse, the company's energetic manager and engineer, for the many facilities which he has placed at our disposal in the preparation of this article, and also to thank those of his staff who so kindly assisted us, including his assistant, Mr. N. S. Tennant, B.Sc., who provided the photographs here reproduced.

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In connection with the commencement of operations, the Yorkshire Electric Power Co. last week held a three days exhibition of electrically-driven machinery.

The exhibits which were all operated from the company's supply, were peculiarly appropriate to the mining interests of the locality and included the following :—

British Thomson-Houston Co., Ltd.—Electric fan, capacity 3,500 ft. of free air per minute at 9 in. water gauge.

Callender's Cable and Construction Co., Ltd.—Types of cables; model of pit shafting, showing method of fixing and jointing cables; types of cleats and casings for cables in pit shafts; cable couplings, fuse and other boxes.

Clarke, Chapman & Co., Ltd.—Electric shipyard winch to lift 3 tons, 50 ft. per minute.

Diamond Coal-Cutter Co.—Disk coal-cutter, fitted with two 10-H.P. motors, to cut 4 ft. 6 in. at floor level, or 3 in. above floor; chain coal-cutter, fitted with two 10-H.P. motors, to cut 4 ft. 6 in. at floor level, or 3 in. above; gate-end switch-box, junction boxes and current leakage indicator.

Hathorn, Davey & Co., Ltd.—Horizontal three-throw ram pump to raise 220 gallons of water per minute 250 ft. high; vertical three-throw high-speed ram pump, to force 54 gallons of water per minute against a head of 300 to 350 ft.; direct-coupled single-stage centrifugal pump, to raise 400 gallons of water 100 ft. high per minute.

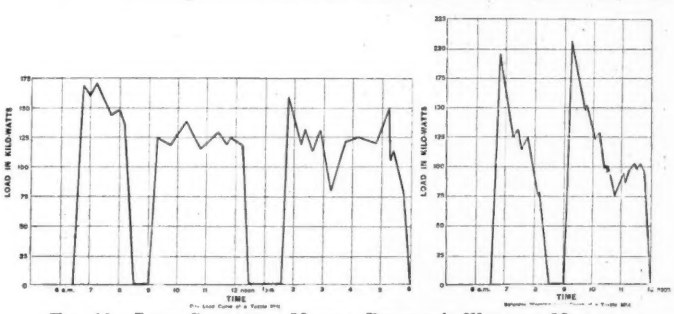


Fig. 12.—Load Curves at Messrs. Burnley's Worsted Mill.

Low Moor Co., Ltd.—Vertical three-throw ram pump 12-H.P., colliery haulage gear.

Mather & Platt, Ltd.—High-lift turbine pump, direct-coupled to motor with flexible coupling, to deliver 150 gallons per minute, 160 ft. high; chain coal-cutter, &c.

Reavell & Co., Ltd.—Portable motor-driven air compressor with free air capacity of 18 cb. ft. per minute, maximum working pressure 30 lb. per sq. in.

Other exhibitors included the British Westinghouse Electric and Manufacturing Co., Bruce Peebles & Co., the Brush Electrical Engineering Co., the General Electric Co., Siemens Bros. & Co., Phœnix Dynamo Manufacturing Co. and Crossley & Co.

The Exhibition, which remained open during August 24th, 25th and 26th, was visited by a large number of representatives of local municipalities and industries, also by members of the Midland Institute of Mining Engineers and of the Colliery Managers' Association.

Fig. 11.—Carding Department.

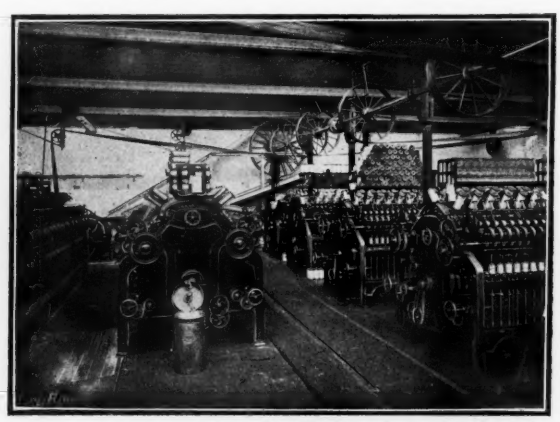

Fig. 13.—Spinning Department.

Views in Messrs. Burnley & Sons' Worsted Spinning Mill.

The company has the distinction of being the first to drive from public mains a complete textile mill, namely, the worsted spinning mill of Messrs. Thomas Burnley & Sons, of Gomersal, views of which are seen in figs. 11 and 13. Other textile manufacturers taking a supply are Messrs. William Lupton & Co., of Pudsey, and Messrs. Booth Bros., of Drighlington.

It is often considered that the load of a mill engine is perfectly steady, but the actual records taken from the above

## BUSINESS NOTES.

(*Continued from page* 341.)

**Catalogues and Lists.**—Messrs. Mavor & Coulson, Ltd., Glasgow.—The firm's calendar and data card for September gives a diagram of a month's cutting with the Pickquick electric coal-cutter, showing its regularity of working.

Messrs. Jones & Horsfield, Denton, near Manchester.—Pamphlet describing and giving tests of the Jones patent sectional and removable boiler and steam pipe covering. Several explanatory diagrams showing the application of the covering to piping, bends, valves and boilers are published, as well as photographic views of boiler and engine houses in a number of electric lighting stations where it is employed. A list is given of some 20 or 30 such stations, in addition to various railway, colliery and engineering works in different parts of the kingdom. The firm executes covering with plastic cements, silicate cotton, sectional and removable sheet-iron casings, or to specification.

The Efandem Co., 67A, Shaftesbury Avenue, W.—Price list of electrical specialities, including "Eco" buzzers, automobile bells, and electric door openers.

The Weston Electrical Instrument Co., Audrey House, Ely Place, London, E.C.—This is a pocket sized catalogue of 120 pp., in which the various types of Weston instruments are described. Although the size of page is small (about 3½ and 4½ in.), the illustrations have not been allowed to suffer in clearness on that account. The catalogue is divided into four parts—(I.) portable and laboratory instruments for direct current; (II.) portable instruments for alternating and direct currents; (III.) switchboard instruments for direct currents; (IV.) diagrams of dimensions and condensed price list of switchboard instruments.

Messrs. Robt. W. Blackwell & Co., Ltd., 59, City Road, E.C.—Entitled "Modern Circuit-Breaker Practice," this 70 pp. catalogue particularises and gives very large views of various types of the well-known "I.T.E." circuit-breakers. The book contains the contents of two bulletins recently issued by Messrs. Blackwell, one being a treatise on these breakers as applied to switchboards, and the other as applied to motor protection. All of the established standards are illustrated, also some recently developed types which are expected to modify present practice in switchboard construction, these new types having been christened with names suggestive of their distinctive features—*i.e.*, reversite, auto-ite, auto-reversite, directite and auto-directite. In arranging the list, every left-hand page has a big bold picture, and the descriptive matter explaining it appears on the right. Outline diagrams are published together at the end of the book.

Messrs. Ferranti, Ltd., Hollinwood.—New brochure (44 pp.) with many well-executed illustrations and full descriptive notes relating to their switchboard measuring instruments for direct and alternating current circuits, their standard moving-coil instruments switchboard transformers, and direct and alternating current relays. A list of some of the electricity supply stations where Ferranti instruments have been installed appears at the end of the list.

Messrs. W. F. Mason, Ltd., Levenshulme, Manchester.—The attractive cover of this list compels the recipient to open it and see what's inside. Therein he will find a brief account, with some clear illustrations, of the "Unique" winch for raising and lowering arc lamps; also a brief recital of its advantages, and a statement of prices.

Messrs. Lacy-Hulbert & Co., Ltd., 91, Victoria Street, S.W.—New catalogue of their "Boreas" patent air compressors, vacuum pumps, showing various combined motor-driven plants and pneumatic appliances. Among the pictures appearing in the list is a photograph of the works at Beddington.

Messrs. R. Waygood & Co., Ltd., Falmouth Road, S.E.—Everybody who knows anything at all about lifts knows the name of Waygood. This new list, which has just been issued, details lifts for private residences, and therefore is gotten up, as the Americans would say, in such a style that any consulting engineer or architect can place it in the hands of his client, feeling sure that it will please. There is some general letterpress relating to both the electric and hydraulic types, and some artistic illustrations show their ornamental appearance. An imposing list covering half a dozen pages gives names of users of Waygood's lifts, from his Majesty downwards.

Electrical Power Storage Co., Ltd., London.—New pocket catalogue giving tabulated data, general particulars, prices, and dimensioned diagrams of the various types of E.P.S. cells for lighting and traction work, also details of their hydrometers, cell inspection lamp, cell testers, &c. Those who want to have their E.P.S. information available in a very convenient form will welcome this pocket list; it is of the size of an ordinary note-book. A number of spare pages have been left for memoranda.

Messrs. Elliott Bros., London.—Two new pamphlets just issued. That numbered "D.C. 50" gives a full description, with general and diagrammatic illustrations of their network ohmmeter (Groves's patent) for testing the joint insulation resistance of a complete network without interrupting the supply. The other, "T.S. 54," deals in a similar manner with "The Century" portable mains testing set for mains superintendents and cable engineers.

**Air Compressors.**—Under this title we have received from Messrs. W. H. Bailey & Co., Ltd., a translation of a paper on air compression, read before the Verein Deutscher Ingenieure, by E. W. Köster. The paper deals with the theory of air compression and the questions which arise in practice in respect of the adiabatic and isothermal methods of compression. Attention is drawn to the important influence of the inlet valves upon the indrawn air which ought not to enter in thin streams between heated surfaces, but should be drawn in as thick streams of as large an area of cross-section as is possible so as to reduce the peripheral area of valve in contact with the inflowing air. The paper is well supplied with diagrams, and may be carefully studied by all who are interested in air compression. Finally, it is claimed that in the Köster air compressor, which is made in this country by Messrs. Bailey, Ltd., the piston valve gear secures all those excellent points to which the study of the subject compels attention if efficiency is to be secured. This, of course, must be very satisfactory, but after raising the reader's interest in this special valve gear, no instructive illustration is afforded him of it, but he is referred to an expensive catalogue in which he may assuage the thirst for further information on Köster compressors.

**Modern Machine Tools.**—This is the title of a small catalogue of machine tools which we have received from Messrs. Alfred Herbert, Ltd., Coventry, who may be said to represent as fully as any firm, modern English machine tool building, devoid of the excessive lightness which characterises so many American tools, and in respect of accessories and fixtures for automatic work, so much less expensive than anything Germany can produce. Indeed, English tool building has nothing to fear from either rival now that the English makers have awakened to modern requirements, and have taken so big a lead in respect of the use of the modern steels. Messrs. Herbert now employ 1,200 men, of whom 200 are in the foundry. Perhaps the special line in which they most excel, is the capstan lathe and automatic machines generally. Such machines, of course, can only give their best output when properly fitted with suitable tools for work to be done in the best rotation of processes. Messrs. Herbert specially apply themselves to assist the users of their machine tools in selecting such correct methods. Accompanying the catalogue is a souvenir in three languages of the firm's exhibit at Liége, and descriptive of the tools forming the exhibit. Anyone interested will receive a copy of the catalogue on sending a postcard requesting it.

**Bankruptcy Proceedings.**—Albert John Harris, Borough Mills, Bower Street, Bradford, electrical engineer.—The debtor's statement of affairs shows liabilities expected to rank, £889 18s., and assets estimated to produce the same amount. He does not admit insolvency. Up to 1892 the debtor, who is 39 years of age, was a journeyman electrical engineer. He then commenced business on his own account as an electrical engineer in Sedgwick Street, Bradford, under the style of "A. J. Harris and Co.". He had no capital, but borrowed £70. At the end of 18 months he removed to Borough Mills. According to balance-sheets prepared in May, 1903-4, he had made, after charging his withdrawals, a net profit of £100 a year on the four years' trading. For the last three years his turnover averaged £1,800 a year, whilst previously it was as high as £6,000 a year. He states that his difficulties have arisen under the following circumstances:—About a year ago, being pressed by his principal creditor, and having failed in his efforts to obtain a partner, he decided to form a limited company for the purpose of taking over his business. This he did, and "A. J. Harris & Co., Ltd." which took over his business, was registered on July 3rd last. The debtor was, according to agreement, to have £750 debentures, £250 in cash, and £94 in ordinary shares, but the company, not being in a position to pay him this cash, increased his debentures to £1,000. He then tried to obtain an overdraft at the bank on the whole of the debentures with, he states, the intention of raising money to discharge the claim of his principal creditor. He was, however, unsuccessful, and the creditor referred to then instituted bankruptcy proceedings against him. The creditors for amounts £10 are as follows:—

| | |
|---|---|
| Chloride Electrical Storage Co., Manchester | £16 |
| Clarke, J. T., Bradford | 10 |
| Craven Bank, Ltd., Bradford | 15 |
| Childe, J. B., Bradford | 22 |
| Electrical Co., Ltd., London | 16 |
| Friends Provident Institution, Bradford | 19 |
| Garnett, W. T., & Co., Bradford | 28 |
| Goossens, Pope & Co., Liverpool | 19 |
| Glover, W. T., & Co., Ltd., Manchester | 15 |
| Hawkins, Bros. & Co., London | 12 |
| Mitchell, Wm., Bradford | 525 |
| Rawlinson & Mitchell, Bradford | 12 |
| Veritys, Ltd., Manchester | 20 |

**Dissolutions and Liquidations.**—Fireproof Electric Switchboard Co., Ltd.—Creditors must send particulars of debts, &c., to Mr. Thomas Lomas, 86, Egerton Street, New Brighton, the liquidator, by September 20th.

Messrs. F. Brown & R. Clowes (F. Brown, scientific instrument makers, 13, Gate Street, Holborn, W.C.), have dissolved partnership. Mr. F. Brown attends to debts.

Turbine Investigation and Advisory Syndicate (J. Tweedy, A. F. Yarrow and Mark Robinson), Sun Buildings, Collingwood Street, Newcastle-upon-Tyne.—Partnership which was formed for investigating as engineers, turbine and other engineering appliances has been dissolved. Mr. R. H. Winstanley, Neptune Works, Walker, has been appointed liquidator, and will attend to debts, &c.

**Trade Announcements.**—The Westinghouse Brake Co., Ltd., have secured the exclusive rights, under the Morse chain patents, to manufacture and sell Morse rocker joint silent high-speed chains in Great Britain and on the Continent of Europe, and have just completed a new building at York Road, King's Cross, N., for the manufacture of these chains. The company are prepared to supply the chains to suit every description of power transmission.

Mr. A. H. Hunt, of 115-117, Cannon Street, E.C., has been appointed agent in London and suburbs for the sale of the Reason

Manufacturing Co.'s arc lamps. Owing to the increasing demand for Reason arc lamps, the company have extended this department of their works at Brighton, and are now making enclosed arc lamps for both alternating and continuous current working in the standard and also the miniature sizes. They are making a speciality of twin carbon lamps, both miniature and standard sizes, for running direct on 200 to 250 volts circuits, a great advantage in the case of a change-over from low to high voltage. The chief feature in the Reason lamps is that they entirely dispense with shunt coils, thereby eliminating what has always been a source of trouble to arc lamp users.

Messrs. Connolly Bros., Ltd., have appointed Mr. Alexander Morrison, of 100, Central Chambers, 12, Waterloo Street, Glasgow, sole agent for the sale of their manufactures for the whole of Scotland, and he will hold stocks for prompt delivery.

## LIGHTING AND POWER NOTES.

**Australia.**—Melbourne.—The report and statement of accounts of the city electricity supply undertaking for the year ended February 28th, has been issued. The principal items, compared with the figures of the previous year, we give below :—

| Year ended February 28th— | 1905. | 1904. |
|---|---|---|
| Total revenue | £69,585 | £64,847 |
| Total working expenditure | £34,742 | £35,267 |
| Gross profit | £34,843 | £29,580 |
| Interest charges | £13,395 | £12,750 |
| Sinking fund | £3,615 | £3,500 |
| Depreciation | £7,231 | £7,000 |
| Net balance | £10,602 | £6,329 |
| Total units sold | 3,981,698 | 3,512,760 |
| Maximum demand | 1,700 kw. | 1,630 kw. |
| H.P. of motors connected | 1,326 | 756 |
| Equivalent 16-c.p. lamps | 78,118 | 65,402 |
| Capital expended to date | £374,280 | £345,823 |

Deducting from the profit balance obtained this year the accrued deficit on the working of the undertaking to February 28th, 1904, there remains a surplus of £9,361. From this sum a special appropriation of £2,000 has been placed to depreciation, and it has been decided out of the annual revenue, from time to time, to recoup the cost of the "changing-over" which has been carried out at a cost of £25,556; £6,000 has been set aside to the credit of capital account for this. £1,000 has been placed as a first contribution to the town fund, and the balance, £361, carried forward. The total amount to the credit of depreciation stands at £21,461.

A new 1,000-H.P. set, together with switchboard extensions, &c., were installed during the early part of this year to meet the winter's load. The lighting of the Eastern Market has been improved by the substitution of 45 flame arcs. During the year the *Age* newspaper has substituted electricity for steam power for driving the whole of its machinery, the motors connected aggregating 212 H.P., and the *Herald* has substituted electric motors for gas engines for a considerable portion of its machinery, and is arranging to adopt electric driving exclusively. The Electric Supply Committee has recommended the following reduction in the prices of energy, to take effect from June 1st, 1905:—Flat rate, from 5d. to 4½d. per unit; maximum demand, from 8d. and 2d. to 7d. and 2d.; and arc lamps, from £22 to £20, £20 to £18, £17 to £15 10s., £15 to £13 10d. The report states that proceedings are being instituted against the Corporation, by the Metropolitan Gas Co., for an injunction to restrain it from supplying energy under the maximum demand system, it being alleged that this is a technical infringement of the Electric Lighting and Power Act. Mr. H. R. Harper, the city electrical engineer, is to be congratulated upon the satisfactory position of the undertaking.

**Batley.**—The annual abstract of the accounts of the Corporation, just issued, shows that during the year ended March 31st last there was a loss of £334, as against a loss in the preceding year of £864. The income from the supply of energy was £3,764, including £2,220 for energy supplied to the tramways. For traction purposes the receipts in the previous year amounted to £898. The gross profit totalled £1,597, and interest and sinking fund charges were £1,931. During the year 100,642 units were sold, as against 31,917 in the previous year. Capital expenditure to date was:—On electricity plant, £36,084; and on tramways, £44,000.

**Bradford.**—Mr. A. S. Blackman, the city electrical engineer, has presented a report in reference to the interruption of supply on August 9th. This was due to the fusing of two of the main cables adjacent to the works. The general supply to the town was discontinued at 6.5 p.m. and reinstated at 9.50 p.m. through temporary connections. Evidence of the cause of the initial mishap was destroyed in the process of the burn-out.

**Continental Notes.**—Germany.—A municipal electricity works is to be established in the town of Scherfelde, Westphalia.

A large generating station of about 5,000 H.P. capacity is about to be erected at the collieries of the Deutsch Luxemburgische Bergban Gesellschaft at Bochum, Westphalia. The energy is to be employed for lighting purposes in and about the mines, and also for the operation of an underground electric coal-hauling tramway.

Sweden.—From the *Financial Times* we learn that a company has been formed at Hamstad, under the name of Sydsvenska Elektriska Aktiebolaget, for the purpose of generating electric power. The share capital is not to be less than 3,500,000 kronor (about £194,500), and not more than 10,000,000 kronor (about £555,500). The object of the undertaking is to supply the towns and industrial centres of the southern part of the province of Halland and the western portion of Scania with electrical power, which, in the first instance, will be generated by means of the Lagaa waterfall.

Italy.—The provincial authorities of Bergamo have granted a concession to the Società per la Ferrorie Ellettrica di Valle Brembana to put down a water-power plant on the River Brembo at Camerata Cornello for generating electrical energy.

Spain.—A company known as La Electrica del Besaya is putting down a plant to utilise the water power of the River Besaya, in the province of Santander; the energy generated is to be employed in the electrolytic production of caustic soda and chloride of calcium.

**Hitchin.**—It is announced that a temporary supply of energy will be available by the end of October. The charge will be 5d. per unit.

**Frinton-on-Sea.**—Messrs. Christy Bros. & Middleton succeeded in supplying electricity to the town again on Saturday last, a week after the destructive fire at their works occurred. By the aid of a local contractor, Mr. A. E. Farr, a brick building, 60 ft. × 28 ft. × 12 ft., cemented, and with a party wall dividing the engine room from the accumulator room, has been erected. The 40-H.P. Crossley gas engine has been overhauled, and is running. The supply at present is, however, shut down at 12.15 a.m., until the new battery is in position.

**Jarrow.**—A summons has been granted against the County of Durham Electrical Power Distribution Co., upon the application of the borough surveyor, to compel the former to put certain roads which it had opened in proper repair.

**Lanarkshire.**—The Middle Ward Committee of the County Council has received notices from the Strathclyde Electricity Supply Co., and the Clyde Electric Lighting Syndicate, Ltd., intimating their intention to apply to the B. of T. for E.L. prov. orders. The Strathclyde company purposes asking powers to generate and supply electricity within part of Bothwell and the parish of Old Monkland, while the Syndicate will seek authorisation to supply electricity within the parish of Bothwell.

**Llangollen.**—Electric light is to be installed throughout the urban area, and the General Purposes Committee has appointed a sub-committee to visit towns to obtain information for the guidance of the authority.

**London.**—Marylebone.—Pending the completion of the Council's generating station at Lisson Grove, energy is being supplied, under agreement, to the Council's customers by the Metropolitan Electric Supply Co.

Hampstead.—The mains staff of the Borough Council electricity department has recently carried out, practically unnoticed, a very creditable feat under the superintendence of the chief assistant engineer, Mr. E. Sayer, and to the instructions and plans of Mr. G. H. Cottam, borough electrical engineer. In the early part of the year the Borough Council purchased the undertaking of the late Hampstead Electricity Co., including the goodwill of 750 consumers, for £12,000. Possession was obtained on May 10th, and on the following day the Corporation officials commenced the work of changing over the consumers. This was no light task, as all the company's mains were overhead, and a large number of houses were wired from the top. In addition, as the old supply was by continuous current, and the Corporation supply is alternating current, every consumer had to be supplied with a new meter, and new D.P. fuses were fixed as well. The company's mains were taken down as each district was completed, and the whole of the work was completed by August 21st, without any dislocation of the supply.

**Manchester.** — An electrician in the employ of the Trafford Park Estates, Ltd., was prosecuted last week before the County Justices, at Manchester, for stealing electrical energy from the Trafford Power and Light Co. It was alleged that the defendant had tapped the energy supplied to his house before it passed through the meter, and thus obtained his light free of cost. He gave an absolute denial to the charge. The stipendiary magistrate, however, said the bench were of opinion that an ingenious fraud had been committed. They fined him £5 and costs, or a month's imprisonment.

**New Zealand.**—Stratford.—The seventh annual report of the Stratford Electrical Supply Co. states that the gross income for the year's working, 1904-5, was £1,752, compared with £1,807 in 1903-4. The total expenditure was £1,342, leaving a credit balance of £410; from this sum, together with £75 brought forward, £867 has been set aside to meet bad debts, depreciation, &c. A dividend of 5 per cent. was declared, and a sum of £33 remained to be carried forward. The number of units sold was 48,936, against 49,260 in the previous year. A dividend of 8 per cent. was paid on the 1903-4 year's working, but during the past year a wash-out occurred, necessitating extensions to the weir costing £370.

**Newport (Mon.).**—The Great Western Railway Co. proposes establishing a new locomotive depôt at Mendelgief, and in connection therewith has applied to the Corporation for terms upon which it would supply electrical energy.

**Pudsey.**—The electric lighting scheme was brought into operation last week. Energy is purchased in bulk by the Corporation from the Yorkshire Electric Power Co. The whole of the compulsory area covered by the prov. order has been wired by the Corporation, some 3½ miles of cables being laid.

**Maidstone.**—On Wednesday evening last week, there was a failure in the supply of energy both for lighting and traction at Maidstone.

**Preston.**—The Streets and Buildings Committee has decided to recommend the Corporation to substitute for the present electric lighting in the main streets, 95 incandescent gas lamps, with two lights each, at a cost of £614. The Council will also be asked to give the National Electric Supply Co. three months' notice terminating the agreement for the supply of electric light. The Gas Co. has agreed to contribute £150 towards the cost of substitution.

**Ripon.**—The T.C. has received from the B. of T. an intimation that, after careful consideration of all the circumstances of the case, the Board has decided to revoke the E.L. order, 1901, forthwith.

**Salford.**—The annual report of the Electricity Department states that the net profit for the past year amounted to £7,514, of which £3,000 has been set apart for depreciation and reserve, and the balance contributed towards the reduction of the rates. Mr. C. D. Taite, the electrical engineer, points out that the sum set aside for depreciation cannot be considered an adequate provision for future contingencies. The gross profit for the year was £40,696, against £42,860 in the previous year. The diminution is due to the reduction made in the price of energy. The capital expenditure during the year was £12,206, making a total capital expenditure of £542,653. During the year 10,221,907 units were generated, 1,409,523 being sold for lighting, 1,411,551 for power, 184,196 for street lighting, and 5,997,040 for traction.

**South Africa.**—Durban.—The Mayor, in his record for the year ended July, say that the continued advance of the electricity department is very marked, some 540 additional consumers having been connected during the past year, bringing the total number to 3,000. There were also 170 consumers for power purposes. The street lighting has been improved by an addition of 25 arc and 323 incandescent lamps. The charge for energy has been reduced by a discount allowance of 10 per cent.

Middleburg.—At a meeting of the T.C., the town clerk was instructed to obtain full particulars of the electric lighting company which the submitter of a lighting scheme claimed to represent.

**Stourbridge.**—The Electric Powers Committee has asked for permission to negotiate with the Shropshire and Worcestershire Electric Power Co., with a view to the Council taking energy from them in bulk on similar terms to those in the agreement formerly proposed with the Midland Electric Corporation, who found they could not legally supply the town. Complaint was made at the meeting of the delay which had taken place in settling the town's electrical policy, and notice was given that at the next meeting a resolution would be moved instructing the Committee to take steps to generate its own supply. This resolution, it was explained, would be withdrawn if, by that time the Shropshire and Worcestershire Co. had come to terms.

**Warrington.**—The report on the past year's working of the electricity undertaking of the T.C. shows a net profit of £1,644.

## TRAMWAY AND RAILWAY NOTES.

**Ayrshire.**—At a meeting of the Ayr County Road Board recently, a draft agreement was submitted in connection with the construction of a tramway from Stevenston through the burghs of Saltcoats and Ardrossan to Seamill, West Kilbride, by the Scottish Electrical Traction Co. A Committee was appointed to consider the whole position.

**Belfast.**—It is understood that the Corporation will make no objection to the application to the Board of Works by the Cavehill and Whitewell Tramway Co. for an extension of the time for the completion of the works authorised by their Act.

The reconstruction of the tramway system has now reached Royal Avenue and High Street. It is expected that traffic will be resumed all over the system by the first fortnight in October. It is intended to fit telephone receivers in all the new cars, in order that in case of accidents the conductors can communicate with the exchange through the street fire alarms.

**Rowley.**—The chairman of the U.D.C. and Mr. C. Woodhouse have been appointed to attend a conference of representatives of neighbouring local authorities to consider the possibility of joint action in future negotiations with the Birmingham and Midland Tramways Joint Committee.

**Dundee.**—The revenue of the Tramways Department for the year was £45,082, and the expenditure, including interest and sinking fund, &c., £45,020, showing a net surplus of £62. The working expenditure was £27,800; interest, £6,800; sinking fund, £5,120; renewal fund, £3,700; depreciation on machinery and plant, £1,400. The operating expenses per car-mile were 7·11d.

**Dundee-Broughty Ferry.**—Work in connection with this scheme is now being carried forward, and it is estimated that it will be completed about the first week in December. The line is double track throughout with the exception of some three-quarters of a mile. Several road widenings, &c., have to be carried out. Milton of Monifieth is the situation of the power station and depôt; the latter will be 229 ft. long, with accommodation for about 30 cars. In the boiler house will be installed three Lancashire boilers, by Messrs. Carmichael, of Dundee, and in the engine room two 200-kw. Belliss-Bruce Peebles sets are to be put down. Messrs. Bruce Peebles will also supply the switch-gear. The contractors for the work are Messrs. J. G. White & Co.

**Glasgow.**—The question of through routes has been under the consideration of the T.C., and Mr. Dalrymple, the general manager, has issued a lengthy report on the subject. He points out that requests have been made repeatedly to have the routes, as arranged, altered or split up, but the Committee has consistently refused such applications, as the number of "through" passengers is very trifling compared with the number travelling from the outside to the centre of the city. It would be ruinous for the department, and unsatisfactory to the public, to run cars from every district to every other district. Changing cars was necessary where there was not a through service to suit each individual, and this entailed extra payment; but, with ½d. fares in operation, this was reduced to a minimum, and there was no loss of time. The responsible officials are convinced that any interference with the existing arrangement would be a grave financial mistake, concludes Mr. Dalrymple, and they recommend the Committee to stand firm on this question.

The T.C. Committee has met deputations who have asked that the tramways be extended from the city in the following directions:—Between Paisley Road and Govan Road; from Giffnock to Mearns; from Cathcart Cemetery Gate to Clarkston; from Baillieston to Coatbridge; and from Clydebank to Duntocher. These representations will receive careful consideration by the Committee.

**London.**—Metropolitan District Railway.—On the 27th ult. electric trains from Wimbledon and Putney to Whitechapel commenced running. With the exception of the inner circle and the London and North-Western trains, the whole of the various services run over the District Co.'s lines are now being worked electrically.

**Manchester and Northenden.**—It has been decided for the present not to construct the proposed tramway to connect Manchester and Northenden by way of Palatine Road, which runs through one of the most important residential suburbs, on account of the great expense which would have to be incurred in road widening. As a substitute for the horse omnibuses now and for some time past in use, the Manchester Corporation will put motor-omnibuses upon the route. The Chorlton-cum-Hardy residents are agitating for an extension of the City tramway line from Brooks's Bar to that growing suburb.

**Monte Video.**—The *Standard* says that on July 25th the Government approved the Bill for the conversion of the Paso de Monno tramway from horse to electric traction.

**New York.**—The New York correspondent of the *Standard* says that the New York Central Railroad has purchased the undertaking of the Canadian Water Power Co., and has also purchased 60,000 h.p. from the American company. The capacity of the combined companies is 580,000 h.p. "The New York Central's acquisition of these interests is believed to indicate a very extensive scheme of electrification on its system, beginning with the Syracuse-Buffalo section."

**Paris.**—The number of passengers who travelled on the Paris Metropolitan Railway during July last was 10,122,390, as against 8,008,846 in the corresponding month last year, and the amount realised on tickets was 1,737,352 fr. Of this sum the municipality receives 561,053 fr., there remaining as net income to the company 1,176,299 fr. The length of line now open is about 19 miles.—*Financial Times.*

**Plymouth.**—When the new section of the Corporation tramways to Pennycomequick was inspected on August 5th by Col. Druitt, of the Board of Trade, he suggested that the cars should carry, in addition to the hand and electric brakes, another brake to render it impossible for the trams to run backwards downhill in the event of the electric power being cut off, the wheels skidding, and the brakes failing to act. Messrs. C. R. Everson, manager of the tramways, and W. H. Sleep (Davey, Sleep & Co., engineers, Plymouth) have invented a new form of brake to meet the case. The invention has been patented, and on Friday last, a very wet day, a test of it was made by the Permanent Way Sub-Committee of the Tramways Committee, with very satisfactory results.

**Rosario.**—The *Review of the River Plate* says that the Rosario Municipality opened the tenders for the construction of a network of electric tramways in that city. Four tenders were received as follows:—

(*a*) Cia. Alemana Transatlantica de Electricidad.—Concession for 70 years, after which period everything would pass over to the Corporation without indemnity of any description. The company to hand over to the municipality 5½ per cent. of the gross receipts whilst the population was under 250,000, 6 per cent. between 250,000 and 400,000, 7 per cent. between 400,000 and 600,000, and

8 per cent. for 600,000 or over. Whatever the population, the quota to be paid to the municipality would never be less than 5 per cent. during the first 25 years, 6 per cent. between 25 and 50 years, and 7 per cent. from 50 to 70 years. In case the gross receipts per kilometre of line were in excess of $45,000, the municipality to receive 12 per cent. of the superavit.

(*b*) Juan O'Connor & Co.—Concession 55 years; to deliver to the Corporation 5 per cent. of the gross receipts during the first 14 years, 6 per cent. for the second 14, and 7 per cent. for the remainder.

(*c*) Dick, Kerr & Co., Ltd.—Concession 75 years, with 4 per cent. during the first 35 years, and 5 per cent. for the remaining period.

(*d*) Belgian Co. (in representation of the following companies: Anversoise de Tramways et d'Enterprises Electriques, of Antwerp; Mutuelle des Tramways, of Brussels; Banco Comptoir, of Brussels).—Concession 55 years, with 6 per cent. during the first 10 years, 7 per cent. for the second 10, and 8 per cent. for the remaining 35.

(*a*), (*b*) and (*d*) are prepared to purchase the horse lines.

The Municipality will probably arrive at a decision some time in September.

**St. Petersburg.**—Laffan's agency reports from St. Petersburg that the T.C. has invited 220 of the largest foreign firms to compete for constructing the town electric tramways, the designs and prices to be lodged by October 28th next.

**South Africa.**—Durban (Natal).—At a meeting of the T.C. on June 27th, the borough engineer reported on the necessity of proceeding with additions to the present car-shed at the electric power station, and it was recommended that tenders be invited for the work. The tramway manager reported on the necessity of having 10 additional cars, as out of the present 46 cars, 44 are in use every evening. It was recommended to refer this matter to the incoming Council. Advice by the last mail says that the six trailers had just arrived, and were being put together.

The Mayor's minute for the municipal year ending July, says that during the year 4·53 miles of track have been laid and electrically equipped, which brings the total length of tramway lines up to 24·41 miles. An additional income will be obtained from advertisements on the cars, whereby a yearly revenue of £1,600 will be secured for the next five years.

Port Elizabeth (Cape Colony).—The second electric tram accident within a month is reported from Port Elizabeth. On August 2nd, when an early morning car of the double-deck type was coming down Walmer Road an axle broke just before a curve into South Union Street, with the result that the car left the rails and caught the verandah of the Tyrone Hotel. Fortunately there was only one passenger, and he, with the driver and guard, escaped uninjured.

Johannesburg (Transvaal).—The Council of August 2nd passed the recommendation that three four-wheel type cars should be ordered at a cost of £1,800 for the conveyance of goods and other traffic on the electric tramway system. It also accepted the tender of Messrs. Strong & Moore, the present contractors for the track, for the third section of tramway track amounting to £51,808. The matter of the general manager and station engineer appointments was discussed in Committee. It is anticipated by the T.C. that the steam tramway will be electrified before the end of the year.

**South America.**—Buenos Ayres.—The Mayor has reported favourably on the request of the Buenos Ayres Electric Tramway Co. to be allowed to construct a branch line to Palermo.

The Municipality has granted a concession to Messrs. Varela, Cuneo Hnos, for the construction and working of an electric tramway for a period of 60 years, joining up with the one for which they hold a concession from the confines of the Municipality to the Tigre.

**Tramway Time Tables.**—Mr. Charles Challenger, the enterprising traffic manager of the Bristol Tramways and Carriage Co., has just issued a pocket time-table for the use of passengers. A supply of copies is carried in all cars in small boxes and all and sundry are invited to take one. The table gives at a glance on each route the number of minutes a car is occupied in running over each section, and the first and last car for week days and Sundays.

**Warrington.**—The last annual report on the municipal tramway undertaking shows a net profit of £451. This sum goes to the reduction of the previous year's deficit.

**Wimbledon.**—The Corporation has disapproved of plans submitted by the London United Tramways in respect to the proposed laying of H.T. cables between the central power station at Chelsea and the projected sub-station at Kingston. Notification has, however, been given that the Council is prepared to approve of the cables being laid along another route (which, it is contended, is shorter and more convenient) subject to the position of the cables being satisfactory to the municipal surveyor and electrical engineer, and to the cables being laid upon a concrete bed at least 3 in. thick. The local authority objects to any streets in the district being disturbed for the purpose of laying cables, unless the company is prepared to proceed continuously with the work.

**Wolverhampton.**—The town clerk has received from the neighbouring local authorities of Willenhall, Bilston, Sedgley, Coseley, &c., the necessary, assents for which the Tramway Committee has been waiting, authorising tramway intercommunication with those districts. Now that this has been obtained, immediate steps are to be taken for the equipment of the Wolverhampton cars by affixing the necessary trolley standards and other apparatus required to connect with the overhead lines of the B.E.T. system outside the borough boundaries, and for the attachment of contact skates along the under portion of the company's cars to enable them to run along the Lorain system into Wolverhampton. No time is to be lost in carrying out this work.

## TELEGRAPH AND TELEPHONE NOTES.

**Berlin Telephones.**—The Berlin correspondent of the *Morning Advertiser* says that telephonic communication within the German Empire continues to make progress, and to-day it is possible to speak from Berlin to more than 2,600 places. There are 280 trunk lines which radiate from Berlin outwards. The telephone exchanges in Germany suspend all work when a thunderstorm is in progress, but this will be no longer the case when all the subscribers' wires are laid underground. This, it is anticipated, will be effected before October, 1906.

**Durban Telephones.**—The new municipal telephone exchange has just been taken over by the Council. Its internal equipment consists of a switchboard for 2,520 lines with an ultimate capacity of 7,200. Good progress has been made with the installation of the central battery system, in connection with which nearly 15 miles of cable have been laid, and there is every prospect that within a few months it will be in operation. The number of subscribers has increased by 78 during the past year, the total now being 1,013. The total number of calls during the year was 3,374,912, the average per subscriber being 9·7 per day. Subscriptions for the year amounted to £11,407 10s.

**Iceland Cable.**—Reuter's Copenhagen agent says it is announced from Reykjavik (Iceland) that both sections of the Althing have now finally approved the agreement with the Great Northern Telegraph Co. for the establishment of cable communication between Iceland and the Shetland and Faröe Islands.

**Indian Telegraphs.**—We sometimes have had the misfortune to find that a passenger could travel quicker by rail, than his messages by wire, over the East India Railway lines. But all that is to be changed. Sanction has been accorded to the provision of new telegraph instruments between Burdwan and Delhi stations in place of those at present rented by the East Indian Railway from the Government Telegraph Department. The cost amounts to about Rs. 40,000.—*Indian Engineering.*

**The Newfoundland Cables.**—The *Daily Mail* announces that Sir Robert Bond, the Premier of Newfoundland, will leave for London shortly, to negotiate a loan of £400,000 to pay the Reid telegraph award and for the laying of the new cable connecting the island of Newfoundland with Canada.

**The Telegraph Service.**—A suggestion is to come before the autumn meeting of the Association of Municipal Corporations, to urge upon the Postmaster-General the necessity for a continuous day and night and Sunday telegraph service to be provided in all towns where the population exceeds 50,000.

### Telegraphic Interruptions and Repairs:—

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Trinidad-Demerara (No. 1) | Aug. 26, 1901 | |
| St. Lucia-Martinique | May 7, 1902 | |
| Dominica-Martinique | May 7, 1902 | |
| Cayenne-Pinheiro | Aug. 13, 1902 | |
| Reissa-Issa (Yemen) Camaran | Oct. 22, 1902 | |
| Tarifa-Tangier | Jan. 18, 1904 | |
| Closed { Vladivostock-Nagasaki | Feb. 9, 1904 | |
| Closed { Port Arthur-Chifu | Mar. 9, 1904 | |
| Jamaica-Colon | Jan. 5, 1905 | |
| Bolama-Bissao | June 21, 1905 | |
| Iquique-Antofagasta | July 21, 1905 | |
| Cadiz-Tenerif | July 20, 1905 | |
| **Landlines.** | | |
| Puerto-Barrios | July 28, 1902 | |
| Kertch-Soutehoum | Sept. 27, 1904 | |
| Alaska landlines | Aug. 27, 1905 | |
| Communication with Brazil *via* Galveston | July 18, 1905 | |

**Telephones v. Tramways.**—In the Bill Chamber of the Court of Session, Edinburgh, Lord Ardwell on Monday had before him a note of suspension and interdict at the instance of the National Telephone Co., Ltd., against the Falkirk and District Tramways Co., Ltd. Complainers asked interdict against the respondents erecting poles and wires and other apparatus in connection with their electric tramways within such distance as would endanger the complainers' wires and apparatus or interfere with or impede the telephonic communication along or by means of the same, and also from turning on electric current within such distance as would endanger the complainers' wires and apparatus.

Complainers based their action on certain sections of the Tramways Act of 1870, incorporated in respondents' special Act, as affording protection against interference with their telephone wires. Respondents contended that these provisions were not applicable, in that tramways worked on the trolley system of electric traction were not in contemplation by the legislature when the Act of 1870 was passed, and they relied upon certain sections in their special Act and regulations made by the Board of Trade in pursuance thereof, as defining the measure of protection afforded to the complainers.

His Lordship, in respect of an arrangement between the parties, whereby the alterations on the complainers' wires are to be carried

out by them under reservation of their claims against the respondents, if liability therefor should ultimately be established, refused the note.

**Telephone Regulations.**—The Post Office circular of 29th ult. states that on 1st inst. calls may be accepted from Post Office telephone exchange subscribers to the National Telephone Co. in the same area or *vice versa*.

In the absence of special instructions, subscribers at the unlimited service rate will not be charged extra for such calls; but in the case of message rate subscribers, intercommunication calls must be registered as local calls. A call for a company's subscriber on an exchange at another town or village in the same area should be registered as *two* calls in all cases in which a subscriber of the company is charged 2d. for a similar call. Inquiry should, when necessary, be made of the company's local representative as to the charge made to their message rate subscribers in such cases. Intercommunication calls will be reckoned against the 30s. minimum payment by message rate subscribers.

In the case of an intercommunication call made from a post office call office, the charge for each three minutes' conversation will be the same as the charge made to a message rate subscriber for an intercommunication call.

No intercommunication call may exceed six minutes if any other call is on hand. Where such calls are effected over trunk junctions, care must be taken that they do not cause delay to the trunk traffic. Any case in which intercommunication calls have a tendency to interfere with trunk or telegram work should at once be reported.

**Wireless Telegraphy.**—The *Daily Telegraph* says that during the voyage of the United States cruiser *Brooklyn* to France recently, tests were made to determine at what distance messages could be received from shore stations. According to an official report made by Lieut. Kaiser, the longest distance at which messages were read during the daytime was 540 miles, while at night a dispatch came quite distinctly, almost twice as far, 1,100 miles. The report does not state which of the wireless systems was used.

Advices from Australia by the last mail, report that the Wireless Telegraphy Bill was read a first time in the Senate of the Commonwealth Parliament at Melbourne. The purpose of the Bill is to give the Postmaster-General the exclusive privilege of establishing, maintaining, and using stations and appliances for:—

(*a*) Transmitting messages by wireless telegraphy within Australia and receiving messages so transmitted.

(*b*) Transmitting messages by wireless telegraphy from Australia to any place on ship outside Australia; and

(*c*) Receiving in Australia messages transmitted by wireless telegraphy from any place or ship outside Australia.

Licenses may be granted by the Postmaster-General to erect, establish, maintain, or use stations and appliances for the purpose of transmitting or receiving messages. Except as authorised by the Act no person shall carry on wireless telegraphy under a penalty of £500. The provisions of the measure are not to apply to His Majesty's Navy or to ships arriving from places outside the Commonwealth, but as regards the latter, appliances are to be subject to the control of the Postmaster-General, and can only be used by his authority.

**Wireless Telegraphy and Moving Trains.**—The recent railway accident near Spremberg, whereby a number of persons were killed owing to one train running into another on a line which is only of single track, and which was caused by a momentary error on the part of a station official, has brought forward the question of using wireless telegraphy for communication between stations and trains in motion on the German railways. It seems that the official knew he had made a mistake, as after the train had started, he tried to stop it by calling out, but this was of no use, and the ordinary railway telegraph service was either not employed or was too late to avert the accident. The fact is recalled that two years ago experiments were made on the military railway between Berlin and Zossen. The telegraph stations along the line were equipped with receivers and transmitters, and a similar apparatus was arranged on the trains. These experiments were continued a few weeks ago, when it was clearly shown that the wireless telegraph station on the moving train was at any moment in touch with any telegraph station along the route, and that intimation could be immediately given of any irregularity, accidents, &c. Similarly, it is possible from any station to warn the driver of a train in motion against the danger of collisions, obstructions on the line, and other dangers incidental to the track.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Ashton-under-Lyne.**—September 2nd. One 500-kw. D.C. generator, water-tube boiler, superheaters, &c. See "Official Notices" August 18th.

**Austria.**—The municipal authorities of Reichenberg, Bohemia, are about to invite tenders for the establishment of a large central station in the town for electric lighting and power supply.

**Belfast.**—September 4th. Coal for the electricity works for one year from October 1st. Specifications from Mr. V. A. H. M'Cowen, City Electrical Engineer, East Bridge Street.

**Bishop Stortford.**—September 26th. The U.D.C. is inviting tenders for lighting such of the public streets as are at present lighted, for two or three years from September 30th, 1905. Thomas Swatheridge, Clerk of the Council.

**Dublin.**—September 1st. The Lighting Committee invites tenders for the electric lighting of the Tara Street Baths.

**Dublin.**—September 18th. Sub-station switchboards, transformers and mains, for the Corporation. See "Official Notices" to-day.

**France.**—The municipal authorities of Dax (Landes) have just invited tenders for the concession for the public and private electric lighting of the town during a period of 35 years.

**Glasgow.**—Sept. 4th. Electric goods elevator for the Corporation electricity department. Specifications from Mr. Lackie, city electrical engineer. (Deposit £2 2s.).

**Ipswich.**—September 14th. Crompton dynamo and motor, also a battery booster, and switchboard alterations, for the Guardians. Mr. E. McGregor Duncan, Consulting Engineer, 27, Old Queen Street, Westminster. Specifications from Mr. R. J. Kent, Clerk to the Guardians, 19, Tower Street, Ipswich.

**London.**—September 5th. Stoneware ducts for electric cables, including manholes, &c., for the L.C.C. See "Official Notices" August 11th.

**London.**—September 29th. Thirty-four tramcar bodies, trucks, equipments, &c., for the L.C.C. See "Official Notices" to-day.

**Mussoorie (India).**—October 23rd. Supply and erection of steel power pipes, water motors, alternators with exciters, switchboards complete, transformers, induction motors, pumps, workshop machines; also bare copper overhead mains, insulators, and lightning arresters, arc and incandescent lamps, telephone equipment, workshop tools and general stores. See "Official Notices" July 14th.

**Oban.**—September 11th. Feeders and distributing mains for the T.C. See "Official Notices" to-day.

**Pembroke.**—September 22nd. Mains, arc lamps and pillars, meters and switchboard panels, for the U.D.C. See "Official Notices" August 25th.

**Pontypridd.**—September 2nd. Permanent way for the U.D.C. See "Official Notices" August 11th.

**Roumania.**—Tenders are invited for a concession for lighting the town of Tulcea by electricity. Tenders are to be delivered within two months (*Curierul Financier*, dated August 6th), and full information may be obtained from the authorities of the town. The upset price is fixed at 500,000 francs.

**Salford.**—September 2nd. Water softening and purifying plant for the electricity department. See "Official Notices" August 18th.

**Salford.**—September 14th. Electric wiring of the new Council Schools. See "Official Notices" to-day.

**Spain.**—October 14th. The Spanish Ministry of Public Works in Madrid is inviting tenders until October 14th for the concession for the construction and working of an electric tramway in Saragossa. Particulars may be obtained from, and tenders are to be sent to, El Ministerie de Obras Publicas, Madrid.

**Stockport.**—September 14th. Electric lighting cables for the electricity department. See "Official Notices" to-day.

**Tyrol.**—Tenders are being called for by the authorities of Telfs (Tyrol) for the construction of an electrical plant.

**War Office.**—September 1st. Tenders invited for the purchase of surplus boilers, dynamos, &c., at Bermuda, Barbados, St. Helena and Woolwich. See "Official Notices" July 7th.

**Watford.**—September 18th. Steel chimney for the electricity department. See "Official Notices" to-day.

### CLOSED.

**Bexley.**—The U.D.C. has accepted the tender of Messrs. J. G. White & Co. for the repaving of the tramway track between Avenue Road and Sandford Road, at £749.

**Bombay.**—The Bombay Electric Supply and Tramways Co., Ltd., has placed an order with the Brush Electrical Engineering Co., Ltd., for sample single-deck and double-deck tramcars complete with trucks and motor equipments.

**Bristol.**—The Docks Committee have accepted the tender of Messrs. Holt & Willetts for the supply of electric lifts for the new tobacco warehouse at Cumberland Basin.

**Mansfield.**—The T.C. has accepted the tender of Messrs. Sansom Bros. for the supply of pipes to the electricity works.

**Neath.**—The R.D.C. has accepted the tender of Messrs. Johnson & Phillips for four sub-station switchboards for the districts of Skewen, Melincrythan, Cadoxton and Aberdulais.

**Port Elizabeth.**—At a recent meeting of the T.C. some discussion took place as to whether the eleven tenders received in connection with the electric light cables should be opened in public or referred to committee unopened. Eventually, they were opened and referred to special committee:—

| | |
|---|---|
| David Fowlds | £7,244 3 0 |
| Dollery & Strange | 28,104 19 2 |
| Holland & Vardy (troughs) | 2,184 14 4 |
| Standard Estate Co. (troughs) | 2,479 10 0 |
| F. J. Middleton | 7,312 8 9 |
| Griffiths & Co. (troughs) | 2,053 4 11 |
| A. G. Knight & G. Allen | 12,740 11 9 |
| Wills & Davey (troughs) | 3,419 17 11 |
| W. M. Smith | 6,141 5 6 |
| Carter & Co. (troughs) | 2,044 11 7 |
| H. J. Beckett | 14,583 0 0 |

**Stockport.**—The B.G. has accepted the tender of Messrs. Strode & Co., of London, for electric cables in connection with the E.L. installation, at £515. Messrs. Johnson & Phillips, Ltd., tendered at £517 10s.

When the tenders came before the meeting of the Guardians Mr. Hollinshead wished to know whether they had been advertised for in the usual way? On the chairman stating that they had not been advertised for, Mr. Hollinshead asked whether the tenders had been opened by the Committee or the architect? The clerk replied that the architect had submitted the two tenders. Mr. Hollinshead did not think it was fair for the tenders to be dealt with by the architect, especially seeing that there was only a difference of £2 10s. in a contract of £500. He wanted to know whether any other tenders were to be dealt with on the same lines. At a later stage in the discussion the clerk explained that the Committee asked the architect to get one tender and he got another to check the first by. The second one was £2 10s. more than the first. Councillor Sharples thought they were too much in the hands of the architect. Mr. Berry contended that the business had been properly carried out, and that they had accepted the tender of the best firm they could lay hands on. The minutes were confirmed.

## BRITISH ASSOCIATION ADDRESSES.

*The President's Address.*—The first part of the Presidential Address delivered by Prof. G. H. Darwin, F.R.S., &c., before the members of the British Association at their meeting in South Africa, was read in Cape Town on August 15th last, and has already been referred to in our columns. The second portion was postponed until the arrival of the visitors in Johannesburg, and was given on August 30th. The address, as a whole, dealt with natural selection (or its equivalent) in inanimate nature; the earlier part, treating of the survival of the fittest chemical elements, compounds and mixtures in and on our own globe, the concluding part having reference to the solar system and the stellar universe. Prof. Darwin sketched briefly the manner in which the existing solar system, and as much of the universe as we are able to think about, are assumed to have attained their present forms either according to Laplace's nebular hypothesis, or the meteoritic theory. He considers that each of these suppositions contains a certain proportion of truth, although they tend to be antagonistic; and he holds the forces which have produced the present configuration of the heavens as analogues of the natural selection that has directed evolution on the earth. For instance, in a system consisting of a sun and a large planet with a large number of small bodies moving in all sorts of ways, most of those small bodies will sooner or later fall into the sun, some of the remainder will fall into the planet, but the residue, having been travelling in perpetual orbits, will survive. Most of the latter, however, will be unstable, because forces, such as tides, will gradually divert them from their safe path, but a few will be immortal. Prof. Darwin proceeded to enlarge upon this theme in a fashion that lies somewhat outside our purview; but towards the end of his speech he touched upon the quarrel which has existed between geologists and physicists since the days of Helmholtz's calculation respecting the age of the earth. Investigators of tidal friction have suggested that 500 or 1,000 million years have elapsed since the birth of the moon, pure geologists have asked for between 50 and 1,000 million years, but physicists have asserted that at the rate at which it is now emitting energy, the sun can only have been active for 20 million. The discovery of radium seems to solve the discrepancy, for it has been shown at length that concentration of matter is not the only source whence the sun may draw its heat; and there is every probability that radium exists in the sun. The amount of energy needed to propel a 12,000-ton ship 6,000 miles at the rate of 15 knots is usually obtained from 5,000 to 6,000 tons of coal; but it is also contained in 22 oz. of radium.

## NOTES.

**Correspondence.**—We have received too late for publication this week, a letter from Messrs. E. Bennis & Co., Ltd., of Bolton, regarding our last week's Note on "Evaporative Trials of Bennis Plant." This will appear in our next issue.

**Prof. Ayrton and Electric Power on the Rand.**—At a meeting of the South African Association of Engineers, Mr. G. A. Denny, the newly-elected President, who took the chair, extended a hearty welcome to Prof. W. E. Ayrton, from England, who was visiting South Africa as a member of the British Association. The chief item on the agenda was a paper by Mr. A. Spier, on "Electric Power Supply in Mines, with Special Reference to Large Winding Plants." Upon the termination of the paper, Prof. Ayrton expressed his appreciation of the Association's welcome, and referred to the pleasure of his visit to South Africa. In connection with the discussion of the evening and the economical storage of electrical energy, he declared that he failed to see why the use of electrical power was so restricted on the Rand to-day. If electric driving is not found advisable for the single property obliged to generate its own power, why were there not large centralisation schemes to serve several mines? So far as he could see, the engineers of the Rand were agreed as to the efficiency of electricity for general mining purposes, readily acknowledged its advantages, and then went no further.

**Sir John Pound on Motor-Omnibuses.**—In the course of his half-yearly speech to the shareholders of the London General Omnibus Co., Sir John Pound made some interesting observations relating to motor-omnibuses. He said that out of the profits of the half-year the board had again carried another £20,000 to the motor fund, so that during the year they had set aside £40,000 for experimental motor services. Of that sum they had used up to June 30th £6,800, and had £33,000 in hand. The directors had organised a repair department under a competent engineering expert, had trained practically a number of drivers, built omnibus bodies in their coach factory, and as the chassis were delivered they would be prepared to put more motor-omnibuses on the roads under the most favourable working conditions. They had expected ere this to have had a larger number of motor-omnibuses at work. Those delivered had all been behind time; some were found on examination to be unsatisfactory, and the board preferred to wait for machines which they believed to be reliable and durable, rather than put a number of vehicles on the road, which would probably result in a heavy working loss. He believed that the motor-omnibus had come to London to stay, but he was equally convinced that some of those now working in our streets would cause their proprietors to wish they had not embarked in so speculative an enterprise. For the first few months, or a year, there was little or no difficulty in showing a good profit on the running of a service of new motor-omnibuses, but maintenance charges increased with the age of the vehicles, and it would be of interest to watch the results of those undertakings which were dependent on motor-omnibuses alone. For some years to come horse traction, which had given such good results in the past, would be the backbone of the company.

**The "Times."**—We can hardly congratulate the Editor of the *Engineering Supplement* of the *Times* on his success as exemplified in an article entitled, "An Innovation in Telegraphy." Ignorance is sometimes admitted as a justifiable plea, but we know that in the "Pilgrim's Progress," a gentleman of that name had a warm time of it. Seriously, however, it is a matter for much regret that subjects of the kind referred to in the article in question, are not dealt with by experts, instead of by those who evidently have no knowledge whatever of what they are writing about, and who talk the usual nonsense as to "far-reaching improvements," "a great impulse will undoubtedly be given to the science," &c. We are told, "By a very simple means, it is asserted that defective insulation can be overcome, and the capacity of the wires or 'leads' (*sic*) can be vastly increased." Briefly speaking, the arrangement devised by Signor Magini appears to be the well-known (not to the *Times* engineering editor, however) Cardew vibratory system, with a coherer as a receiver, and its far-reaching capabilities, we are informed, are as follows:—

"The device works equally well whatever the distance between the telegraphic stations and whatsoever the material condition may be of the wires in use on existing lines. There would thus be no need to make alterations in existing services, but it may be pointed out that with the new system telegraphic communication may also be carried out under existing generic conditions by means of very

thin wires, instead of the thick and expensive conductors or 'leads' now generally employed—a point of exceptional importance, especially in connection with the erection of new installations. All competent (!) persons will at once recognise the importance of the innovation from the above brief remarks as to the actual condition of telegraphic wires. As a matter of fact, interruptions in telegraphic services depend almost always upon defective insulation of the conductors (especially during bad weather), upon short circuits, or upon 'earths'; fortunately, all these causes have no effect at all upon the transmission of the new currents selected and practically employed by Signor Magini. These currents are of an oscillating character and neither disturb nor are disturbed by ordinary currents—a fact the significance of which cannot escape the attention of those who understand anything about telegraphy (!); furthermore, they have the singular property of rapidly passing over electric conductors even when such 'leads' are imperfectly insulated (whether due to bad weather or other causes) or if they have not been insulated at all, and also if short-circuited to earth, or if the continuity be interrupted. To put the matter briefly, the new 'Magini system' ensures perfect telegraphic communication under even the worst possible conditions in the electric *status* of the leads." (! !)

"With the new Magini system the use of cumbersome and expensive batteries of cells or accumulators at telegraphic stations becomes a thing of the past."

"A further, and very valuable, application of this system lies in its practicability for use in submarine work; not only does it double the power of the cable, but it also enables two messages to be sent together over one and the same cable."

Criticism of the brilliant knowledge of the subject, as displayed in the foregoing extracts, is hardly necessary. There are few of our readers, we hope, who, if they were really ignorant, would care to let the world know the fact in such an unblushing manner.

**Mishap at Rochdale Electricity Works.**—There was a partial shut-down at the Rochdale municipal electricity works on Saturday last, the 26th ult. From an official account we gather that the particulars of the affair are as follows:—At about 8.30 p.m. the main fuse on one of the generators supplying the lighting mains blew, and as only one machine was then running, the supply, of course, was cut off from the town. The generating plant consists of direct current machines and three-phase alternators, also a motor-alternator which is capable of receiving three-phase current, and generating for either tramway or lighting purposes, and also *vice versa*. At the time mentioned one machine was running the lighting load, and another the traction load. The latter was assisted by the motor-alternator receiving its supply from one of the steam-driven alternators, the exciting current for the steam alternator and also the motor-alternator being supplied from the lighting bus-bars. The condensers and station motors were also being supplied from the lighting bus-bars as well as the lighting arrangement in the station. The blowing of the fuse cut off the excitation of the alternators, and also the supply to the various motors and station lighting. The loss of vacuum threw off the steam sets on to the atmospheric exhaust main which naturally, to a certain extent, reduced the power of the sets. The traction load was too much for the D.C. machine supplying it, and was further added to by the fact that the motor-generator losing its excitation on the A.C. side, the D.C. side received current, and was motored off the traction bus-bars, the A.C. machine becoming a generator driving the A.C. steam generator, thus throwing a heavier load still on the traction machine. The latter started pulling up, and it was necessary to trip the automatics on some of the traction feeders frequently, so as to relieve the machine. It was about half an hour before the tramway supply was righted, but it was never totally stopped. As the machine fuses on the lighting board had not previously given any trouble, it appeared probable that it was due to some fault on the mains (during the last few days a number of faults have occurred due to cables being damaged during tramways construction, and also to some work carried out by other departments of the Corporation). It afterwards proved that the fuse had been faulty. A separate machine was run up to take the station lighting and motors, and in the meantime the lighting network had, to a certain extent, been subdivided. Some difficulty was experienced in recommencing the supply as, of course, only having motor-balancers and a motor-generator, which alone would not be sufficient to take the load, the engines had to be run up and kept on the stop valve until such time as the balancers could be put in. As soon as this was done, the various sections of the distributors had to be re-connected, which accounted for the main portion of the delay in renewing the supply. The various sections of the town were out for periods varying from 10 minutes to 1½ hours, but by 10 o'clock everything was straight again.

This is the first complete shut-down due to any fault in the generating station since the plant commenced supply in October, 1900, and it is not a bad record when it is remembered that during that time, for many months Mr. C. C. Atchison and his staff had to run without any spares, and, further, that during the last winter both the traction and lighting switchboards were completely dismantled, and temporary arrangements had to be made until such time as the reconstructed boards could be erected and connected up in their new positions in the switch room.

**Electric Shock Fatality.**—It is reported in the daily Press that, on Monday, Mr. Sidney Dixon, aged 21, an employé of Messrs. Dick, Kerr & Co., Ltd., while showing an assistant which parts to touch or not to touch at the power station of the Hastings tramways, placed his hand on a live part and was killed instantly. The inquest was to be held yesterday.

**New Zealand Water Power and Electric Railways.**—The *Times* in its *Engineering Supplement* says:—"The Government and the people of this colony are at the present time devoting a good deal of attention to the question of the development of cheap electrical energy from the natural water supplies, and in connection with this subject a report from a Swiss expert, M. Edmund Allo, on the transformation of railways by electric traction has just been presented to Parliament. In the course of this report M. Allo says:—'The cost of equipping the present 3 ft. 6 in. line electrically would be the cost of trolley-wire overhead and the copper bonding of the present road-bed, which can be calculated at about £300 per mile. The electric locomotives, containing each 2 × 64 = 128 H.P., would be sufficient to run all your ordinary trains on the existing grades. I understand that the power used in the whole of the North Island for the railway engines amounts to about 4,000 H.P. By taking rotary transforming units of 500 H.P., at a cost all complete of about £4,000 per unit, eight units would be required for actual working, and two units as a reserve—that is, in case the whole of the transformation from steam to electricity would be made at once. The three-phase alternating current with 50,000 volts primary potential could be transformed on the electric locomotives into 2,000 or even 550 volts alternating three-phase current, doing away with the rotary transformers which change the alternating three-phase into 550-volt direct current, thereby saving expense and simplyfying the whole system. Of course, if only part of the lines should be equipped, from one to several rotary transformation units could be put up. The electric locomotive would pull the present cars. All over the world the economy of electrical power over steam has been calculated at 40 per cent. There are about 1,000 miles of railways in the North Island south of Auckland. The equipment without the power station can be reckoned at about £500 per mile; 1,000 miles would therefore cost £500,000.'"

**Appointment Vacant.**—Station engineer for Dartford (£100).

**Electrolysis with Alternating Currents.**—A paper dealing with the above subject was read before the German Bunsen Society at its last general meeting by Dr. Le Blanc, of Carlsruhe. He pointed out that an alternating current does not act upon copper electrodes in a copper sulphate solution, because the metal dissolved when the current is passing in one direction, is deposited when the change occurs. But a permanent effect is produced, and Faraday's law obeyed, whenever there is opportunity for the deposited metal to enter into combination (*e.g.*, copper in cyanide solution) or to be converted into an insoluble compound (*e.g.*, lead in carbonate solution, where white-lead is formed) before the current alters in direction; and also when some other reaction takes place more easily than the deposition of the metal (zinc in acid solution). The speed of the reactions in question and the frequency of the current play important parts in the process. If the frequency is low, an electrode may be completely dissolved; if the frequency is somewhat higher, dissolution may be imperfect, and if it is very rapid, the electrode may be unattacked. Again, if the current is asymmetrical, *i.e.*, if one period is three times as long as the other, the electrode which serves as anode for the longer time will lose 50 per cent. in weight, and the other will gain the same amount. When copper is melted and quenched in alcohol, it exhibits an abnormally low potential, and it does not dissolve as readily as it increases in weight; in the above case, therefore, the electrode acting as cathode for the longer period increases more than 50 per cent. It is also curious that the newly deposited copper shows the low potential of the original electrode, viz., a potential 0·013 volt lower than that of ordinary crystalline copper. Metals that become passive when used as anodes with a direct current, exhibit the property of dissolving more freely with an alternating current, as the frequency rises up to a certain point, after which a greater frequency causes them to dissolve less freely; and there is probably some connection between this maximum point and the speed with which the metal assumes the passive condition.

## OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

**Central Station Engineers.**—Mr. J. F. THOMAS, who has been acting as resident engineer in Johannesburg for Messrs. Mordey & Dawbarn, the consulting engineers to the T.C. in connection with the electric lighting and tramways schemes, is to be appointed general manager of the tramway and lighting department on the recommendation of the General Purposes Committee. As already announced, Mr. J. A. MCMULLEN has been appointed to take charge of the station.

Mr. S. C. CLAYTON, formerly of Cork Electricity Works, has been appointed assistant engineer to the Leatherhead and District Electricity Co., Ltd. The chief engineer, Mr. Petty, on behalf of the staff, presented Mr. Harding (who is leaving for Acton) with a case of pipes.

On Friday last Mr. FRANCIS T. TILLSON, mains superintendent to the Northampton E.L. & Power Co., Ltd., was presented with a writing table by the staff and employés on the occasion of his

marriage. The presentation was made by Mr. P. M. Chapman, assistant engineer.

Mr. C. W. Jackson, of Patricroft, has been appointed assistant electrical engineer at King's Lynn electricity works.

**Tramway Officials.**—On August 22nd, at the Roman Catholic Cathedral, Portsmouth, the marriage took place of Vittorio Giovanni Lironi, M.I.M.E., A.M.I.E.E., engineer to the Portsmouth Tramways, to Ruth Carlyle, third daughter of W. T. Maddock, Esq., of Southsea.

Mr. R. Baron, rolling-stock superintendent of the Sheffield Corporation Tramways, has been presented by the employés of the Tinsley and Queen's Road sheds, with a case of cutlery on his departure to take up the position of depôt superintendent for the L.C.C. Tramways.

**General.**—Mr. C. T. Yerkes, who has lately been laid up with a severe attack of gout, has left for the Continent, where he will remain until early in October.

**Obituary.**—The death is announced of Mr. Thomas Mason, who, 18 months ago, retired from the position of chief of the traffic department of the Postal Telegraphs. For many years he was manager of the United Kingdom Telegraph Co., and he was taken over with that company when the acquisition by the State took place in 1871. Upon his retirement he received the decoration of the Imperial Service Order.

## CITY NOTES.

### Aberdeen Suburban Tramway Co.

Mr. G. Walker presided at the half-yearly meeting held at Aberdeen on August 25th. He moved the adoption of the report, which recommended a dividend of 2½ per cent. He said the sum of £1,000, which was proposed to be set aside for a renewal and depreciation account, was a fair one. Compared with the amount of the company's capital expenditure, it was a larger sum than was set aside by any other electric company last year or by the Corporations of some towns where the tear and wear of the system was as great as, if not greater than, on the Aberdeen Suburban lines. The company's heaviest drawback was the price which had to be paid to the Corporation for its electricity, and he thought they might let them have it for 1½d. per unit instead of 2½d.

Mr. John Thomson seconded, but expressed the opinion that a dividend should not have been paid until the suburban tramways were more developed.

The report was adopted.

**Wm. Griffiths & Co.**—The report of the committee of shareholders which inquired into the reason of the company's losses during the year, shows that the results of the period were decidedly exceptional. Pending the award in the arbitration between the company and the Middlesex County Council, the committee considers that it would be unwise of the board to declare an interim dividend for the current six months' trading, even if earned. The report says:—"Assuming that no repetition of the 'special' incidents of the past two years occur, it is reasonable to suppose that with able commercial and financial management, free from all speculative company promotion, so soon as the present unfavourable influences cease to operate, the company's prosperity will be resumed."

**Stock Exchange Notices.**—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Newcastle and District Electric Lighting Co., Ltd.—£150,000 4½ per cent. mortgage debenture stock.

And to allow the following securities to be quoted in the Official List:—

Folkestone Electricity Supply Co., Ltd.—Further issue of £25,000 4½ per cent first debenture stock.

**British Insulated and Helsby Cables.**—The directors announce an interim dividend for the half-year ended June 30th of 8 per cent. per annum on the ordinary shares. The interim dividend declared in 1904 was at the same rate.

**Electric Supply Corporation.**—At an extraordinary meeting held at Salisbury House, E.C., last week, the alterations in the articles were confirmed.

**Northern Counties Electricity Supply Co.**—The directors have declared an interim dividend at the rate of 3 per cent. per annum.

**Calcutta Electric Supply Corporation.**—The number of units delivered to consumers during the four weeks ending July 28th, 1905, were 416,207, compared with 318,517 in the corresponding four weeks of the preceding year.

## STOCKS AND SHARES.

Wednesday evening.

After many days, the eagerly-anticipated has happened. Peace had been so extensively discounted in advance that the Stock Exchange was quite prepared to see the consummation of its hopes followed by reaction. Instead of this, however, there was a smart rise in most Stock Exchange sections, and prices were especially good in the speculative divisions. But while other markets are astir with excitement, the electricity departments look on comparatively unmoved. There are rises in plenty to record, although they do not amount to appreciable fluctuations, and they were mostly scored before the news of peace arrived on Tuesday evening.

Telegraph and Telephone securities present the firmest front this week. Amazon shares have gone back ¾ certainly, the recent swift advance tempting a few shares to the market. The Debentures, however, remain at 77½. West African Telegraphs are up another 15s., the price having now attained its par value of £10. West Coast of America rose $\frac{1}{16}$ to 12s. 6d., but West India and Panama Ordinary slid back the ⅛ rise they gained last week, the price being level with West Coast of America shares. About half a dozen Debenture stocks are ½ to 1 better. Direct Spanish Telegraph Preference improved ⅛ to 9½. Eastern Telegraphs added a point at 144½, and Indo-Europeans went ½ better to 53. The Anglo-American group was easier after its smart jump, but since the dealings in the American Railroad market are more furious than ever, the company should be doing well, and on the news of peace the Preferred rose ½ and the Deferred ⅜. National Telephones have a few rises to their credit; Oriental Preference are $\frac{1}{16}$ better at 1¼, the same price as the Ordinary shares; and United River Plates put on the fraction at 7¼.

Three points rise in City and South London Ordinary stock brings the price to 41, and the buying, which so far has been of quite a retail nature, appears to be due to prospects of what the line may earn when the Euston extension is completed. Central Londons keep their prices, and District stock remains at 36. When the carriages are provided with racks, comfortable armrests (in place of the present "rests"), a convenient system of ingress and egress, quieter running capacity and such like odd details, the line may tap more of the Central London's traffic than it does now. Metropolitan Consolidated is harder at 92, and so is Baker Street and Waterloo 4 per cent. Debenture at 102. Waterloo and City rose a point, otherwise electrical railway stocks have not altered much.

Tramway issues, with a very few exceptions, are a good market. British Electric Traction Preference dropped ¼ to 102¾ in sympathy with the weakness of the Ordinary shares, although the two Debenture stocks are slightly better. Anglo-Argentine Ordinary have spurted to 9⅛, the Preference being 6 and the Debenture stock 142½—the last practically not to be bought. Calcutta Trams, old and new, have both advanced ¼, to 10 and 9¼ respectively. No change has occurred in Belgrano Ordinary at 3⅛, but it will be surprising if they do not have a move before long. Colombo Electric Tramways and Lighting 5 per cent. Debenture is 104, and business in Sunderland District Electric Trams Debentures is being done at 98, and a shade less. Havana Electric Railway 5 per cent. coupon bonds have just received an official quotation, and are called 95 to 97. In view of the boomlet now in progress in Cuban Railway descriptions, the circumstances of these electric railway bonds will be worth watching. London United Preference shares continue at 10.

Two changes are all that the electricity supply list can command this week. One is a further 10s. rise in St. James's to 14½, and the other a ⅜ rise in Metropolitan Electrics to 10⅜. People who buy Metropolitans contend that the company has now reached a position and standing far superior to that of the ordinary lighting concern. Only part of its undertaking falls beneath the operation of the 1888 Act, and all sorts of fancy visions are held out—they may be reasonable enough *qua* visions—with regard to the future prosperity of the company.

Several of the miscellaneous descriptions have hardened, Electric Constructions rising a further 2s. 6d. to 15s., India-Rubber 10s. to 16 on the increase in the price of rubber, and Telegraph Constructions £1 to 34, because of the improvement in the general telegraph market. Callender's Debenture, undervalued for some time past, is 1½ points up at 108½. Henley Debenture, also bearing 4½ per cent. interest, stands at 110, but this is *cum* dividend, whereas the next Callender dividend does not become due until December. Westinghouse Preference at 2½ has yet to derive benefit from the presence of Mr. George Westinghouse on this side of the Atlantic.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last four years. 1902. | 1903. | 1904. | § 1905. | Closing Quotations August 23rd. | Closing Quotations August 30th. | Business done week ended August 30th, 1905. Highest | Lowest. | Rise + or Fall — |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 34,800 | African Direct Telegraph, 4 % Debs... | 100 | 4 % | 4 % | 4 % | .. | 99—102 | 99 —102 | .. | .. | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | Nil | Nil | Nil | .. | 3½— 4 | 2⅞— 3¼ | .. | .. | — ⅜ |
| 119,760£ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | Nil | Nil | Nil | .. | 75 — 80 | 75 — 80 | 78 | .. | .. |
| 763,580 | Anglo-American Telegraph .. .. .. | Stock | 60/6 | 61s. | 2⅝% | 29s. | 59 — 61 | 59 — 61 | 59½ | .. | .. |
| 3,118,210 | Do. do. do. 6 % Pref. .. .. | Stock | 6 % | 6 % | 5⅞% | 58s. | 106 —107 | 106 —107 | 106⅝ | 105⅝ | .. |
| 3,118,210 | Do. do. do. Deferred .. .. | Stock | 1/- | 2s. | Nil | .. | 15⅜— 15⅝ | 15⅜— 15⅝ | 15 11/16 | 15 3/16 | + ¼ |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 .. .. .. | 5 | 6 % | 7 % | 8 % | .. | 7⅛— 7⅜ | 7⅛— 7⅜ | .. | .. | .. |
| 1,932,856£ | Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red. | Stock | 4 % | 4 % | 4 % | .. | 96½— 96¾ | 96¼— 96½ | .. | .. | .. |
| 16,000 | Cuba Telegraph .. .. .. .. .. | 10 | 6⅔% | 10 % | 5 % | .. | 8⅝— 9¼ | 8½— 9¼ | 9¼ | 9 | .. |
| 6,000 | Do. 10 % Pref. .. .. .. .. | 10 | 10 % | 5 % | 10 % | .. | 17 — 18 | 17 — 18 | .. | .. | .. |
| 12,931 | Direct Spanish Telegraph, Ord. .. .. .. | 5 | 4 % | 4 % | 4 % | .. | 3⅜— 3⅝ | 3⅜— 3⅝ | .. | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. .. | 5 | 10 % | 10 % | 10 % | .. | 9¼— 9¾ | 9¼— 9¾ | .. | .. | .. |
| 30,000 | Do. do. 4½ % Debs. .. .. | 50 | 4½% | 4½% | 4½% | .. | 100 —103 | 100 —103 | .. | .. | .. |
| 60,710£ | Direct United States Cable .. .. .. | 20 | 3½% | 3 % | 3½% | .. | 11½— 11¾ | 11⅝— 11⅞ | 11¾ | 11⅝ | + ⅛ |
| 74,500 | Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R. | 100 | 4½% | 4½% | 4½% | .. | 100 —102 | 100 —102 | .. | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock .. .. | Stock | 7 % | 7 % | 7 % | .. | 142 —145 | 143 —146 | 145¼ | 143½ | + 1 |
| 2,000,000 | Do. 3½ % Pref. Stock .. .. | 100 | 3½% | 3½% | 3½% | .. | 90¼— 91½ | 90½— 92½ | 92 | 90½ | .. |
| 1,836,814 | Do. 4 % Mort. Deb. Stock Red. .. | Stock | 4 % | 4 % | 4 % | .. | 107¼—105½ | 108 —110 | 109 | 108¼ | + ½ |
| 300,000 | Eastern Extension, Australiasia, and China Tele. | 10 | 7 % | 7 % | 7 % | .. | 13⅜— 14¼ | 13⅜— 14¼ | 14 7/16 | 13 15/16 | .. |
| 602,400 | Do. 4 % Deb. Stock .. .. .. | Stock | 4 % | 4 % | 4 % | .. | 105 —107 | 105¼—107½ | 106½ | .. | + ½ |
| 300,000 | East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909 | 100 | 4 % | 4 % | 4 % | .. | 99 —101 | 99½—101½ | 100 | .. | + ½ |
| 200,000£ | Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | 4 % | 4 % | 4 % | .. | 101 —103 | 101½—103½% | .. | .. | + ½ |
| 180,887 | Globe Telegraph and Trust .. .. .. | 10 | £3 16 7* | 5⅜% | 5⅜% | .. | 10⅝— 10¾ | 10⅝— 10¾ | 10¾ | 10 11/16 | .. |
| 180,887 | Do. do. 6 % Pref. .. .. | 10 | 6 % | 6 % | 6 % | .. | 14⅜— 14⅝ | 14⅜— 14⅝ | 14 7/16 | .. | .. |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 12½% | 15 % | 24 % | .. | 35 — 36 | 35 — 36 | 33⅝ | .. | .. |
| 46,500 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | 4½% | 4½% | 4½% | .. | 99 —101 | 100 —102 | .. | .. | +1 |
| 17,000 | Indo-European Telegraph .. .. .. | 25 | 10 % | 10 % | 13 % | .. | 51½— 53½ | 52 — 54 | 53½ | .. | + ½ |
| 72,680 | Monte Video Telephone Co., Ltd. Ord. .. .. | 1 | 3 % | 3 % | .. | .. | ⅜— ½ | ⅜— ½ | .. | .. | .. |
| 1,983,333 | National Telephone, Pref. Stock .. .. .. | 100 | 6 % | 6 % | 6 % | 6 % | 109½—110½ | 110 —111 | 110⅝ | 109 | + ½ |
| 1,966,667 | Do. do. Def. Stock .. .. .. | 100 | 4½% | 5 % | 5 % | 5 % | 107 - 109 | 107½—108½ | 108½ | 108 | .. |
| 15,000 | Do. do. 6 % Cum. 1st Pref. .. .. | 10 | 6 % | 6 % | 6 % | 6 % | 13 — 14 | 13 — 14 | 13⅜ | 12⅜ | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. .. .. | 10 | 6 % | 6 % | 6 % | 6 % | 12 — 13 | 12 — 13 | .. | .. | .. |
| 250,000 | Do. do. 5 % Non-cum. 3rd P., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5 % | 5⅝— 5¾ | 5⅝— 5¾ | 5 13/16 | 5 3/32 | .. |
| 2,000,000 | Do. do. 3½ % Deb. Stock Red. .. | Stock | 3½% | 3½% | 3½% | .. | 99½—100¾ | 99½—101½ | 100 | .. | + 1 |
| 1,689,593 | Do. do. 4 % Deb. Stock Red. .. | 100 | 4 % | 4 % | 4 % | .. | 104 —106 | 104 —106 | 105 | .. | .. |
| 179,313 | Oriental Telep. and Elec. 1 to 171,504, fully paid | 1 | 6 % | 6¾% | 6¾% | .. | 1 3/32— 1 5/32 | 1 3/32— 1 5/32 | .. | .. | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. .. | 1 | 6 % | 6 % | 6 % | .. | 1 5/16— 1 11/16 | 1 5/16— 1 11/16 | .. | .. | + 1/16 |
| 100,000 | Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | 4 % | 4 % | 4 % | .. | 98 —101 | 99 —102 | .. | .. | .. |
| 11,839£ | Reuter's .. .. .. .. .. .. | 8 | 5 % | 5 % | 5 % | .. | 7⅞— 8 | 7⅞— 8 | .. | .. | .. |
| 3,237 | Submarine Cables Trust .. .. .. .. | Cert. | 6 % | 6 % | 6 % | .. | 127—130 | 127—130 | .. | .. | .. |
| 58,000 | United River Plate Telephone .. .. .. | 5 | 7 % | 8 % | 8 % | .. | 6⅞— 7⅛ | 7 — 7⅛ | 7 3/16 | .. | + ¼ |
| 40,000 | Do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | 5 % | 5 % | 5 % | .. | 5¼— 5⅜ | 5⅛— 5⅜ | .. | .. | .. |
| 179,947 | Do. do. 5 % Debs. .. .. .. | Stock | 5 % | 5 % | 5 % | .. | 109 —111 | 109 —111 | .. | .. | .. |
| 15,609£ | West African Telegraph, Shares .. .. | 10 | 2 % | 4 % | 4½% | .. | 9 — 9¼ | 9⅜— 10¼ | .. | .. | + ⅜ |
| 30,008 | W. Coast of America, 1 to 30,000 & 53,001 to 53,008 | 2½ | Nil | Nil | Nil | .. | ⅜— ⅝ | ⅜— 1/16 | .. | .. | + 1/16 |
| 150,000 | Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel. | 100 | 4 % | 4 % | 4 % | .. | 100 —102 | 100 —102 | .. | .. | .. |
| 207,930 | Western Telegraph, Ltd., Nos. 1 to 207,930 .. | 10 | 7 % | 7 % | 7 % | .. | 13⅜— 14¼ | 13⅜— 14¼ | 14⅛ | 13 13/16 | .. |
| 75,000 | Do. do. 5 % Debs. 2nd series, 1906 | 100 | 5 % | 5 % | 5 % | .. | 100 —102 | 100 —102 | .. | .. | .. |
| 563,380 | Do. do. 4 % Deb. Stock Red. .. | 100 | 4 % | 4 % | 4 % | .. | 102 —104 | 102½—104½ | .. | .. | + ½ |
| 88,321 | West India and Panama Telegraph .. .. | 10 | Nil | Nil | Nil | .. | 1 1/16— 1 3/16 | 1 1/16— 1 3/16 | .. | .. | .. |
| 34,563 | Do. do. 6 % Cum. 1st Pref. .. .. | 10 | 7 % | 7 % | 6 % | .. | 8¾— 9 | 8¾— 9 | 8⅞ | .. | .. |
| 4,669 | Do. do. 6 % Cum. 2nd Pref. .. .. | 10 | Nil | Nil | Nil | .. | 6¼— 6⅜ | 6½— 7 | .. | .. | + ⅛ |
| 80,000£ | Do. do. 5 % Debs., Nos. 1 to 1,800 .. | 100 | 5 % | 5 % | 5 % | .. | 101 —104 | 101 —104 | .. | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 40,000 | British Aluminium 7 % Cum. Pref. .. .. .. | 5 | Nil | Nil | Nil | .. | 4⅜— 5⅛ | 4⅜— 5⅛ | 5⅛ | 5 1/16 | .. |
| 20,000 | Do. do. "A" 6 % Cum. Pref. .. .. | 5 | Nil | Nil | Nil | .. | 4⅜— 5⅛ | 4⅜— 5⅛ | .. | .. | .. |
| 20,000 | Do. do. 4 % Funding Certs. .. .. | 5 | .. | .. | .. | .. | 2¼— 3⅛ | 2¼— 3⅛ | .. | .. | .. |
| 800,000£ | Do. do. 5 % 1st Mort. Deb. Stock Red. | Stock | 5 % | 5 % | 5 % | .. | 99 —103 | 99 —103 | 102 | .. | .. |
| 133,301 | British Electric Traction .. .. .. .. | 10 | 8 % | 6 % | 6 % | .. | 8½— 8⅝ | 8½— 8⅝ | 8⅝ | 8½ | .. |
| 156,437 | Do. do. 6 % Cum. Pref. .. .. | 10 | 6 % | 6 % | 6 % | .. | 10½— 11¼ xd | 10⅜— 11 | 10 5/16 | 10⅛ | — ⅛ |
| 1,000,000£ | Do. do. 5 % Perp. Deb. Stock .. | Stock | 5 % | 5 % | 5 % | .. | 122 —124 | 123 —125 | .. | .. | +1 |
| 250,000 | Do. do. 4½ % 2nd Deb. Stock Red. | 100 | .. | .. | 4½% | .. | 97 — 99 | 98 —100 | 99 | 98⅜ | +1 |
| 100,000 | British Insulated and Helsby Cables .. .. | 5 | 10 % | 8 % | 8 % | 8 % | 5¾— 6 | 5¾— 6 | 5⅞ | 5⅝ | .. |
| 100,000 | Do. do. 6 % Cum. Pref. .. .. | 5 | 6 % | 6 % | 6 % | 6 % | 5¾— 6 | 5¾— 6 | .. | .. | .. |
| 500,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | 4½% | 4½% | 4½% | 4½% | 102 —105 | 102 —105 | .. | .. | .. |
| 50,000 | ¶Browett, Lindley & Co., Ord. .. .. .. | £1 | Nil | Nil | Nil | .. | 1 1/16— 1 3/16 | 1 1/16— 1 3/16 | .. | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. .. | £1 | Nil | Nil | Nil | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. | .. |
| 105,731 | Brush Electrical Engineering, Ord., 1 to 105,731 .. | 2 | Nil | Nil | Nil | .. | ⅜— ½ | ⅜— ½ | .. | .. | .. |
| 150,000 | Do. Non-cum. 6 % Pref. .. .. | 2 | 6 % | 6 % | 6 % | .. | 1⅛— 1⅜ | 1⅛— 1⅜ | .. | .. | .. |
| 125,000£ | Do. 4½ % Perp. Deb. Stock .. | Stock | 4½% | 4½% | 4½% | .. | 92 — 95 | 92 — 95 | 94½ | .. | .. |
| 125,000£ | Do. 4½ % Perp. 2nd Deb. Stock | Stock | 4½% | 4½% | 4½% | .. | 78 — 81 | 78 — 81 | .. | .. | .. |
| 35,000 | Callender's Cable Construction shares .. .. | 5 | 15 % | 12½% | 12½% | .. | 10 — 11 | 10 — 11 | .. | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref. .. .. .. | 5 | 5 % | 5 % | 5 % | .. | 5¼— 5⅜ | 5¼— 5⅜ | .. | .. | .. |
| 300,000 | Do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | 4½% | 4½% | 4½% | .. | 105 —108 | 107 —109 | .. | .. | +1 |
| 1,963,208 | Central London Railway, Ord. Stock .. .. | Stock | 4 % | 4 % | 4 % | 4 % | 88 — 90 | 88 — 90 | 89¼ | 88¼ | .. |
| 523,396 | Do. do. 4 % Pref. Stock .. | Stock | 4 % | 4 % | 4 % | 4 % | 101 —103 | 101 —103 | 102½ | 101 | .. |
| 523,396 | Do. do. Def. do. .. .. | Stock | 4 % | 4 % | 4 % | .. | 77 — 80 | 77 — 80 | 79 | 78⅜ | .. |
| 1,330,000 | City and South London Railway .. .. .. | Stock | 3½% | 2½% | 2½% | 2 % | 37 — 39 | 40 — 42 | 42 | 39 | +3 |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 .. .. .. | 3 | 5 % | 2½% | 2½% | .. | 1¾— 2 | 1¾— 1⅞ | .. | .. | — ⅛ |
| 100,000£ | Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red. | .. | 5 % | 5 % | 5 % | .. | 94 — 99 | 94 — 99⅝ | .. | .. | .. |
| 99,261 | Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261 | 5 | Nil | Nil | .. | .. | 1⅜— 1⅝ | 1⅜— 1⅝ | .. | .. | .. |
| 17,139 | Do. "A" shares, 01—017,139 .. | 5 | Nil | Nil | .. | .. | 2 — 2¼ | 2 — 2¼ | .. | .. | .. |
| 344,023£ | Do. 4 % Deb. Stock Red. .. .. | 100 | 4 % | 4 % | 4 % | .. | 83 — 88 | 83 — 88 | .. | .. | .. |
| 100,000£ | Do. 5 % 2nd Deb. Stock Prov. Certs. all pd. | 100 | 5 % | 5 % | 5 % | .. | 89 — 94 | 89 — 94 | .. | .. | .. |
| 112,100 | Electric Construction 1 to 112,100 .. .. | 2 | 6 % | 4 % | Nil | .. | ⅜— ½ | ⅜— ⅝ | ½ | .. | +⅛ |
| 31,390 | Do. do. 7 % Cum. Pref., 1 to 31,390 | 2 | 7 % | 7 % | 7 % | .. | 1⅝— 2¼ | 1⅝— 2¼ | .. | .. | .. |
| 200,000 | Do. do. 4 % Perp. 1st Mort. Deb. Sk. | Stock | 4 % | 4 % | 4 % | .. | 92 — 95 | 92 — 95 | .. | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. .. | 10 | 5 % | 5 % | 5 % | .. | 9¾— 10 | 9¾— 10 | .. | .. | .. |
| 200,000 | Do. do. 4 % Mort. Deb. .. | Stock | 4 % | 4 % | 4 % | .. | 97 —101 | 97 —101 | .. | .. | .. |
| 200,000 | Henley's (W. T.), Telegraph Works, Ord. .. .. | 5 | 20 % | 15 % | 15 % | 10% | 11¼— 12¼ | 11¼— 12¼ | 12¼ | 12 | .. |
| 200,000 | Do. do. 4½ % Pref. .. .. | 5 | 4½% | 4½% | 4½% | .. | 5⅝— 5⅞ | 5⅝— 5⅞ | .. | .. | .. |
| 45,900 | Do. do. 4½ Mort. Deb. Stock | Stock | 4½% | 4½% | 4½% | .. | 109 —111 | 109 —111 | .. | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works. . | 10 | 10 % | 10 % | .. | .. | 15 — 16 | 15¼— 16¼ | 16¼ | 15⅜ | + ½ |
| 300,000£ | Do. do. 4% 1st Mort. Deb. .. | 100 | 4 % | 4 % | 4 % | .. | 100 —103 | 100 —103 | .. | .. | .. |
| 37,500 | †Liverpool Overhead Railway, Ord. .. .. | 10 | 1½% | 1⅜% | 1½% | .. | 3 — 3⅛ | 2⅞— 3 | .. | .. | — ⅛ |
| 10,000 | † Do. do. Pref. £10 paid .. | 10 | 5 % | 5 % | 5 % | 5 % | 9 — 9½ | 9 — 9½ | .. | .. | .. |
| 97,350 | Telegraph Construction and Maintenance .. | 12 | 20 % | 20 % | 15 % | .. | 32 — 34 | 33 — 35 | 33¾ | 33 | +1 |
| 150,000£ | Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909 | 100 | 4 % | 4 % | 4 % | .. | 102 —104 | 102 —104 | .. | .. | .. |
| 540,000£ | Waterloo & City Railway, Ord. Stock .. .. | 100 | 3½% | 3½% | 3½% | 3 % | 89 — 91 | 90 — 92 | 90½ | .. | +1 |

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
¶ From Manchester Share List.

Bank rate of discount 2½ per cent. (March 9th, 1905).

## SHARE LIST OF ELECTRICAL COMPANIES *(continued)*.—ELECTRICITY SUPPLY COMPANIES.

| Present Issue. | NAME. | Stock or Share. | Dividends for the last four years. 1902. | 1903. | 1904. | ‡1905. | Closing Quotations Aug. 23rd. | Closing Quotations Aug. 30th. | Business done week ended Aug. 30th, 1905. Highest | Lowest. | Rise + or Fall— |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 29,377 | Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000 | 5 | 8 % | 10 % | 10 % | .. | 10 — 10½xd | 10 — 10½ | .. | .. | .. |
| 10,623 | Do. do. 7 % Cum. Pref. | 5 | 7 % | 7 % | 7 % | .. | 9⅝— 10½xd | 9⅝— 10⅝ | .. | .. | .. |
| 288,782 | Central Electric Supply 4 % Guar. Deb. Stock .. | 100 | 4 % | 4 % | 4 % | .. | 103 —106 | 103 —106 | .. | .. | .. |
| 80,000 | Charing Cross and Strand Electricity Supply .. | 5 | 10 % | 8 % | 8 % | 5 % | 6⅜— 7⅛ | 6⅜— 7⅛ | .. | .. | .. |
| 80,000 | Do. do. do. 4½ % Cum. Pref. | 5 | 4½% | 4½% | 4½% | .. | 5⅛— 5⅜ | 5⅛— 5⅜ | 5⅜ | .. | .. |
| 40,000 | Do. "City Undertaking" 4½ % Cum. Prf. | 5 | 4½% | 4½% | 4½% | .. | 4 13/16— 5 1/16 | 4 13/16— 5 1/16 | 4⅞ | .. | .. |
| 40,000 | Do. do. 1903 .. .. .. | 5 | .. | 4½% | 4½% | .. | 4⅛— 5⅛ | 4⅛— 5⅛ | .. | .. | .. |
| 350,000 | Do. do. 4 % Deb. Stock Red. .. | 100 | 4 % | 4 % | 4 % | .. | 103 —105 | 103 —105 | .. | .. | .. |
| 44,436 | *Chelsea Electricity Supply, Ord. .. .. .. | 5 | 4½% | 5½% | 6 % | .. | 6½— 6⅝ | 6½— 6⅝ | .. | .. | .. |
| 150,000£ | Do. do. 4½ % Deb. Stock Red. .. | Stock | 4½% | 4½% | 4½% | .. | 108 —110 | 108 —110 | .. | .. | .. |
| 70,595 | City of London Elec. Lighting, Ord. 40,001—110,595 | 10 | 5 % | 5 % | 6 % | .. | 10½— 11 | 10½— 11 | 10⅝ | .. | .. |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 .. .. | 10 | 6 % | 6 % | 6 % | .. | 13 — 14 | 13 — 14 | 13⅞ | 13⅜ | .. |
| 400,000£ | Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd. .. | .. | 5 % | 5 % | 5 % | .. | 123 —127 | 123 —127 | .. | .. | .. |
| 300,000 | Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd. | 100 | 4½% | 4½% | 4½% | .. | 103 —105 | 103 —105 | .. | .. | .. |
| 40,000 | County of London Electric Lighting, Ord. 1—40,000 | 10 | 4 % | 4 % | 4½% | 4 % | 8½— 9 | 8½— 9 | .. | .. | .. |
| 30,000 | Do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | 6 % | .. | 12 — 12½ | 12 — 12½ | 12⅝ | .. | .. |
| 400,000£ | Do. do. 4½ % Deb. Stock .. .. | .. | 4½% | 4½% | 4½% | .. | 111 —114 | 111 —114 | .. | .. | .. |
| 250,000 | Do. do. 4½ % 2nd Deb. Stock .. | Stock | 4½% | 4½% | 4½% | .. | 103 —105 | 103 —105 | 104 | .. | .. |
| 70,000 | Edmundson's Electric Corporation, Ord. Shares .. | 5 | 7 % | 7 % | 7 % | .. | 5⅞— 6⅛ | 5⅞— 6⅛ | .. | .. | .. |
| 80,000 | Do. do. 6 % Cum. Pref... .. .. | .. | 6 % | 6 % | 6 % | .. | 6 1/16— 6 3/16 | 6 1/16— 6 3/16 | .. | .. | .. |
| 300,000£ | Do. do. 4½ % 1st Mort Deb. Stk | 100 | 4½% | 4½% | 4½% | .. | 106 —108 | 106 —108 | .. | .. | .. |
| 21,000 | Kensington and Knightsbridge Electric Ord. .. | 5 | 10 % | 12 % | 12 % | .. | 11¾— 12⅞ | 11⅞— 12⅞ | .. | .. | .. |
| 136,000 | Do. do. do. 4 % Deben. Stk. | Stock | 4 % | 4 % | 4 % | .. | 97 —100 | 97 —100 | .. | .. | .. |
| 111,000 | London Electric Supply Corporation, Limited, Ord. | 3 | Nil | Nil | 3 % | .. | 2 — 2⅛ | 2 — 2⅛ | .. | .. | .. |
| 60,000 | Do. do. do. 6 % Pref... | 5 | 6 % | 6 % | 6 % | .. | 5 — 5⅛ | 5 — 5⅛ | .. | .. | .. |
| 371,895 | Do. do. 4 % 1st Mort. Deb. Stk. Red. | Stock | 4 % | 4 % | 4 % | .. | 99 —102 | 99 —102 | 101¼ | 101 | .. |
| 100,000 | Metropolitan Electric Supply, 1 to 100,000 .. .. | 5 | 7½% | 8½% | 10 % | 10% | 9⅝— 10⅜ | 10⅛— 10⅜ | 10 1/16 | 10 3/16 | +⅛ |
| 76,121 | Do. 4½ % Cum. Pref. 1—71,106, £3 pd. | 5 | 4½% | 4½% | 4½% | .. | 5⅛— 5⅜ | 5⅛— 5⅜ | 5 11/16 | .. | .. |
| 220,000£ | Do. 4½ % 1st Mort. Deben. Stock .. | .. | 4½% | 4½% | 4½% | .. | 109 —113 | 109 —113 | .. | .. | .. |
| 250,000£ | Do. 3½ % Mort. Deben. Stock Redem. | Stock | 3½% | 3½% | 3½% | .. | 98 —100 | 98 —100 | .. | .. | .. |
| 250,000 | Midland Electric Corporation, 4½ % 1st Mort. Deb. | 100 | 4½% | 4½% | 4½% | .. | 99 —101% | 99 —101% | 101 | .. | .. |
| 10,852 | Notting Hill Electric Lighting .. .. .. | 10 | 6 % | 6 % | 7 % | .. | 14 — 15 | 14 — 15 | .. | .. | .. |
| 59,000 | Do. do. 4 % 1st Mort. Deb... .. | 100 | 4 % | 4 % | 4 % | .. | 100 —102 | 100 —102 | .. | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. .. | 5 | 14½% | 14½% | 14½% | 10% | 13½— 14½ | 13⅛— 14⅛ | 14⅛ | 13⅞ | .. |
| 20,000 | Do. do. 7 % Pref. 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 7 % | 8 — 9 | 8 — 9 | 8⅝ | .. | .. |
| 150,000£ | Do. do. 3½ % Deb. Stock Red. .. | 100 | 3½% | 3½% | 3½% | .. | 97 — 99 | 97 — 99 | .. | .. | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. .. .. | 5 | 2½% | 4 % | 4 % | .. | 2⅜— 2⅝ | 2⅜— 2⅝ | .. | .. | .. |
| 50,000 | Do. do. do. 4 % Deb. Stock | Stock | 4 % | 4 % | 4 % | .. | 76 — 80 | 76 — 80 | .. | .. | .. |
| 65,000 | South London Electricity Supply, Ord. .. .. | 5 | 12½% | 3 % | 4 % | .. | 3¾— 4 | 3¾— 4 | .. | .. | .. |
| 100,000 | South Met. Elec. Lt. & Power { Ord.. .. .. | 1 | Nil | Nil | Nil | .. | 1 3/16— 1 5/16 | 1 3/16— 1 5/16 | .. | .. | .. |
| 50,000 | *(Late Blackheath and Greenwich* { 7 % Pref... .. | 1 | Nil | 7 % | 7 % | .. | 1 1/16— 1 1/8 | 1 1/16— 1 1/8 | .. | .. | .. |
| 100,000 | *Dist. E.L.Co.)* { 4½ % 1st Deb. Stk. | 100 | 4½% | 4½% | 4½% | .. | 106 —109 | 106 —109 | .. | .. | .. |
| 30,000 | Urban Electric Supply, Ord. .. .. .. .. | 5 | 5 % | 5 % | 5 % | .. | 4⅜— 4⅝ | 4⅜— 4⅝ | 4 13/16 | .. | .. |
| 30,000 | Do. do. 5 % Cum. Pref. .. .. | 5 | 5 % | 5 % | 5 % | .. | 5⅛— 5⅜ | 5⅛— 5⅜ | .. | .. | .. |
| 200,000 | Do. do. 4½ % 1st Mort. Db. Stk. Red | 100 | .. | .. | 4½% | .. | 105 —107 | 105 —107 | 106½ | 106 | .. |
| 110,000 | Westminster Electric Supply, Ord. .. .. .. | 5 | 12 % | 13½% | 14 % | 13% | 12½— 13½ | 12½— 13½ | 13 | 12⅝ | .. |
| 28,151 | Do. do. 5 % Cum. Pref. .. | 5 | 5 % | 5 % | 5 % | .. | 6⅛— 6⅜ | 6⅛— 6⅜ | .. | .. | .. |

Shares not officially quoted:—Mackay Companies, ord., 42—43. Pref. 75—76.

*Subject to Founders Shares. † Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| Locality. | Fortnight ended. | Receipts for the fortnight. £ | £* | No. of wks. | Total to date. £ | £* | Route miles open. * |
|---|---|---|---|---|---|---|---|
| Aberdeen .. .. | Aug. 26 | 3,240 | — 510 | 13 | 20,507 | — 1,230 | .. .. |
| Ayr .. .. .. | „ 19 | 954 | + 18 | 14 | 5,848 | — 99 | 8 .. |
| Bath .. .. .. | „ 23 | 1,636 | + 107 | 34 | 23,026 | + 1,594 | 13 .. |
| Birkenhead .. .. | „ 27 | 2,148 | + 54 | 27 | 22,755 | — 493 | 13·5 .. |
| Blackburn .. .. | „ 23 | 2,149 | + 277 | 21½ | 21,957 | + 773 | 14·25 .. |
| Blackpool .. .. | „ 24 | 6,217 | + 895 | 21 | 29,485 | + 1,186 | 11·87 .. |
| „ —Fleetw'd | „ 26 | 4,383 | + 925 | 8 | 11,909 | — 673 | 8 .. |
| „ — Lytham | June 22 | 1,602 | + 753 | 34 | 7,608 | .. .. | 7½ .. |
| Bolton .. .. | Aug. 27 | 4,437 | + 354 | 22 | 43,517 | + 1,714 | 26 + 1 |
| Bournemouth .. | „ 23 | 4,243 | +1,306 | .. | .. | .. | 13·91 + 3¾ |
| Bradford .. .. | „ 26 | 9,623 | + 214 | 21 | 96,759 | — 4,036 | 48 .. |
| Brighton .. .. | „ 27 | 2,831 | + 70 | 22 | 24,556 | .. | 9·5 .. |
| Bristol .. .. | „ 25 | 10,254 | + 244 | .. | .. | .. | 28·5 .. |
| **Brit. Elec. Trac. Co.** | | | | | | | |
| Airdrie .. .. | Aug. 18 | 440 | + 39 | 33 | 6,579 | — 6 | 8·5 .. |
| Barnsley .. .. | „ 18 | 382 | — 8 | „ | 5,319 | — 189 | 3 .. |
| Barrow .. .. | „ 18 | 721 | + 229 | „ | 7,965 | + 1,836 | 5·37 .. |
| ‡Birmingham (City) | „ 18 | 10,686 | +1,160 | „ | 180,738 | + 3,696 | 14·5 .. |
| Birmingham (Mid.) | „ 18 | 3043 | + 629 | „ | 54,721 | + 2,653 | 12·25 .. |
| Devonport .. .. | „ 18 | 1,136 | — 77 | „ | 15,398 | — 2,022 | 8·85 .. |
| Dudley—Sto'rb'ge | „ 18 | 2,473 | + 557 | „ | 29,886 | + 1,299 | 21·25 .. |
| Gateshead .. .. | „ 18 | 2,031 | + 145 | „ | 30,151 | + 581 | 11·25 .. |
| Gravesend, N'fleet | „ 18 | 661 | + 75 | „ | 7,649 | — 874 | 6·5 .. |
| Gr'n'k, Pt. Glsgw | „ 18 | 1,493 | + 124 | „ | 21,037 | + 2,327 | 7·25 .. |
| Hartlepool .. | „ 18 | 693 | — 18 | „ | 8,730 | — 1,047 | 6·72 .. |
| Kidderminster .. | „ 18 | 450 | + 138 | „ | 4,107 | — 222 | 4·5 .. |
| Leamington .. | „ 18 | 591 | + 312 | 5 | 1,284 | + 517 | .. .. |
| Merthyr .. .. | „ 18 | 439 | + 49 | 33 | 6,331 | — 303 | 2·9 .. |
| ‡Metropolitan .. | „ 18 | 7,906 | +4,099 | „ | 85,172 | +39,678 | .. .. |
| Middleton .. .. | „ 18 | 822 | + 101 | „ | 11,377 | + 615 | 8·5 .. |
| Oldham — Ashton | „ 18 | 1,313 | + 120 | „ | 18,189 | + 268 | 9·13 .. |
| Peterborough .. | „ 18 | 458 | + 84 | „ | 4,637 | — 390 | 5·31 .. |
| Potteries .. .. | „ 18 | 3,563 | + 148 | „ | 55,607 | + 320 | 29 .. |
| Rothesay .. .. | „ 18 | 1,310 | + 575 | „ | 6,887 | + 1,787 | 2·75 .. |
| Sheerness .. .. | „ 16 | 226 | + 31 | „ | 2,350 | + 289 | 2·5 .. |
| Southport .. .. | „ 18 | 1,038 | + 169 | „ | 10,401 | — 436 | 8·17 .. |
| South Staffs. .. | „ 18 | 1,758 | + 477 | „ | 23,671 | + 147 | 13·87 .. |
| Swansea .. .. | „ 18 | 2,297 | + 965 | „ | 22,613 | + 4,560 | 5·5 .. |
| Taunton .. .. | „ 18 | 173 | + 15 | „ | 1,670 | — 180 | 1·5 .. |
| Tynemouth .. | „ 18 | 987 | + 140 | „ | 8,922 | — 978 | 3·75 .. |
| Weston-s-Mare .. | „ 16 | 1,035 | + 294 | „ | 4,630 | + 407 | 3 .. |
| Wolverhampton D. | „ 18 | 1,048 | + 241 | „ | 12,882 | + 15 | 14·75 .. |
| ‡Worcester .. .. | „ 18 | 881 | + 129 | „ | 10,137 | + 627 | 5·75 .. |
| Wrexham .. .. | „ 18 | 250 | + 18 | „ | 3,353 | — 321 | 4 .. |
| Yorks. Wool. Dist. | „ 18 | 1,536 | + 270 | „ | 31,354 | + 1,701 | 17 .. |
| Burnley .. .. | Aug. 26 | 2,341 | + 160 | .. | .. | .. | 7·5 .. |
| Burton-on-Trent .. | „ 27 | 715 | — 91 | 21 | 7,169 | .. | 8·5 .. |
| Bury .. .. .. | „ 20 | 1,689 | .. | 20 | 15,232 | .. | 10·5 .. |

| Locality. | Fortnight ended. | Receipts for the fortnight. £ | £* | No. of wks. | Total to date. £ | £* | Route miles open. * |
|---|---|---|---|---|---|---|---|
| †Cardiff .. .. | Aug. 12 | 4,941 | — 44 | 19 | 41,853 | + 605 | 17·6 .. |
| Carlisle .. .. | „ 26 | 449 | + 26 | 34 | 6,378 | — 385 | 7 .. |
| Chatham and Dist. | „ 24 | 1,529 | + 243 | 34 | 22,751 | + 2,623 | 9·33 + ·8 |
| Colchester .. .. | „ 23 | 524 | — 154 | 4 | 1,087 | .. .. | 7 .. |
| †Cork .. .. .. | „ 24 | 525 | + 35 | 34 | 16,684 | + 799 | 9·89 .. |
| Darlington .. .. | „ 26 | 436 | + 24 | 21 | 4,422 | .. .. | 4·87 .. |
| Darwen .. .. | „ 25 | 537 | + 41 | 21 | 5,240 | + 244 | 4·36 .. |
| †Dover .. .. | „ 12 | 344 | + 27 | 32 | 6,651 | — 268 | 3·5 .. |
| Dublin .. .. | „ 25 | 11,716 | — 44 | .. | 45,669 | + 365 | 48·5 + 1½ |
| †Dundee .. .. | „ 16 | 893 | + 51 | .. | .. .. | .. .. | .. .. |
| East Ham .. .. | „ 28 | 1,776 | + 268 | 21 | 18,480 | + 1,693 | 6·75 .. |
| Glasgow .. .. | „ 26 | 30,073 | +1,980 | 12½ | 190,729 | + 9,986 | 76 + 5 |
| Gloucester .. .. | „ 23 | 658 | — 24 | 20½ | 6,795 | .. .. | 15 .. |
| Halifax .. .. | „ 23 | 4,159 | + 905 | 21 | 35,653 | + 2,010 | 37 + 4 |
| †Huddersfield .. | „ 26 | 3,145 | + 411 | 21 | 29,151 | + 671 | 28 .. |
| Hull .. .. .. | „ 26 | 4,414 | + 71 | 21 | 47,008 | + 662 | 13 .. |
| †Ilford .. .. | „ 5 | 530 | — 205 | 18 | 9,199 | — 291 | 6·5 .. |
| Ilkeston .. .. | „ 23 | 280 | — 65 | 21 | 2,642 | — 536 | 3·5 .. |
| Ipswich .. .. | „ 26 | 1,122 | — 106 | 21 | 10,312 | — 1,102 | 10·5 .. |
| Isle of Thanet .. | „ 26 | 3,708 | — 233 | 34 | 22,899 | — 2,074 | 11 .. |
| Kirkcaldy .. .. | „ 23 | 476 | — 97 | .. | .. .. | .. .. | 7·5 .. |
| Lan'kshire Trm. Co. | „ 24 | 1,864 | + 495 | 34 | 23,880 | + 2,290 | 12·5 + 3·9 |
| Leeds .. .. | „ 26 | 11,936 | + 376 | 21 | 133,907 | + 3,929 | 89·5 + 8 |
| †Leicester .. .. | „ 26 | 2,146 | .. | 34 | 71,045 | .. .. | .. .. |
| Liverpool .. .. | „ 19 | 23,238 | +1,890 | 33 | 349,582 | + 8,164 | 103 .. |
| L.C.C. .. .. | „ 12 | 32,843 | +3,185 | 19 | 292,367 | +50,467 | 51½ + 5½ |
| Lowestoft .. .. | „ 26 | 989 | + 122 | .. | .. .. | .. .. | .. .. |
| Manchester .. .. | „ 26 | 26,447 | +1,555 | 21 | 279,864 | +12,099 | .. .. |
| †Newcastle .. .. | „ 19 | 3,704 | + 75 | 20 | 78,633 | + 2,754 | .. .. |
| Newport .. .. | „ 26 | 1,221 | + 150 | 21 | 13,096 | + 1,918 | .. .. |
| Oldham .. .. | „ 26 | 3,643 | +1,115 | 22 | 36,928 | +10,138 | 23·75 +5·87 |
| Plymouth .. .. | .. | .. | .. | .. | .. .. | .. .. | .. .. |
| Pontypridd .. .. | „ 26 | 306 | .. | 21 | 3,605 | .. | 3·75 .. |
| †Portsmouth .. | „ 19 | 3,150 | + 644 | 20 | 46,329 | + 1,849 | 14·5 .. |
| †Reading .. .. | „ 10 | 880 | .. | 19 | 12,572 | — 143 | 7·5 .. |
| Rochdale .. .. | „ 26 | 2,086 | +1,576 | 20 | 16,348 | +12,954 | 20·5 +14 |
| †Salford .. .. | „ 21 | 4,419 | + 493 | 20 | 92,041 | + 6,263 | .. .. |
| Scarborough .. | „ 26 | 997 | .. | 34 | 5,816 | .. | 4·5 .. |
| Sheffield .. .. | „ 27 | 9,815 | + 588 | 22 | 110,283 | + 5,089 | 35·75 -2·75 |
| †Southampton .. | „ 16 | 1,161 | + 74 | 20 | 20,396 | — 270 | .. .. |
| Southend-on-Sea .. | July 26 | 1,089 | + 67 | 17 | 6,596 | + 468 | 6·25 .. |
| Stockport .. .. | Aug. 18 | 2,097 | + 809 | 20 | 14,855 | + 2,253 | 14·5 + 3 |
| †Sunderland .. | „ 28 | 1,452 | + 6 | 20 | 29,680 | + 786 | .. .. |
| Tyneside .. .. | „ 23 | 868 | + 90 | 34 | 14,419 | + 1,302 | 8·87 .. |
| Warrington .. .. | „ 24 | 727 | + 78 | 21 | 7,252 | + 348 | 7·75 + ·25 |
| West Ham .. .. | „ 24 | 4,415 | +2,116 | 21 | 35,589 | +14,238 | 13·25 + 4·6 |
| Wolverhampton .. | „ 23 | 1,732 | + 183 | 21 | 17,431 | .. | 10 .. |
| Cen. London Rly. | Aug. 26 | 10,502 | — 398 | 8 | 45,423 | — 1,157 | 6 .. |
| City & S. Lon. Rly. | „ 27 | 4,541 | + 49 | 8 | 18,033 | — 223 | 6·25 .. |
| Dublin-Lucan Rly. | „ 25 | 302 | + 27 | 8 | 1,210 | + 10 | 7 .. |
| G. N. and City Rly. | „ 26 | 2,739 | + 662 | 8 | 11,385 | + 3,456 | 3·5 .. |
| L'pool Overh'd Rly. | „ 27 | 3,289 | + 10 | .. | 14,960 | — 409 | 6·67 .. |
| Mersey Railway .. | „ 26 | 3,065 | + 234 | 8 | 12,307 | + 766 | 4·5 .. |

* Compared with the corresponding period of 1904. † One week only. ‡ Includes horse and other receipts.

When comparing the returns of this, with those for the corresponding period of last year, it should be borne in mind that Bank Holiday was a week later this year. The receipts of the Birmingham and Midland and City of Birmingham show a decrease owing to the omnibus receipts of those companies having hitherto been included.

# ELECTRIC TRAMWAY AND RAILWAY EXHIBITION, 1905.

## Description of Interesting Exhibits.

*(Continued from page 320.)*

Messrs. Hadfield's Steel Foundry Co., Ltd., had a representative exhibit, in which were included all kinds of points and crossings in "Era" manganese steel. The movable points were fitted with Hadfield's patent mechanism fixed in a box on the side of the points. This box not only gives efficient drainage, but is so arranged that it will take the mechanism for either movable or automatic points, and the conversion from one to the other can be performed in a few minutes.

Photographs and drawings were shown illustrating some of the special work designed and constructed for the London County Council, Bradford, Liverpool, Leith, Bolton, Glasgow, Belfast, and other Corporations. There was also on view a photograph and a diagram of the lay-out constructed for the Fitzalan Square Junction, Sheffield. This junction is constructed entirely of "Era" manganese steel, including all the curved rails. This piece of special work was put to work on September 5th, 1901, and has had 4½ millions of cars over it, or an average of 3,200 cars per day, whilst the average wear is only 0·156 in., so that although the lay-out has been at work nearly four years, it still gives evidence of a further two to three years' work. It should be noted that the special work in ordinary cast steel, and ordinary rolled steel rails, which the manganese steel work replaced, had a life of less than three months.

These facts are most extraordinary, and let in a good side light on the real cost of maintaining track under heavy service. A few years ago ordinary cast steel of good quality was believed to be sufficient for points and crossings, but now the very curves have to be put down in manganese steel.

If the adoption of radial action trucks, or the further use of bogie cars, will reduce this preposterous wear, it ought to be considered most carefully. Presumably the trouble is not effaced, but merely transferred by putting in harder rails, and special work for the wear must come somewhere, and it is the wheels which suffer.

Messrs. Hadfield made rather a point of Le Rossignol's Patent Portable Cross-Over, which consists of a set of six ramps, packed when out of use in a box which is kept near the situation of a cross-over from one track to another. These permanent cross-overs are put in for emergency or special purposes only, and when they are wanted in a hurry they never work, because the wear has been all on the "through" side of the castings. The Le Rossignol patent does away with this objectionable feature, and the modified castings allow quiet running and reduced wear of wheels, while the portable ramps are always ready and always reliable because they are not worn unevenly.

Traffic charges on tramway systems in which there are a number of branch lines are increased in direct ratio to the number of points which have to be turned.

In those cases where human point-turners are employed this amount is ascertainable by simple reference to the wages book, but in other cases where the work is done by the motorman or conductor of each car as it passes one way or the other over a junction the cost can be estimated only, but it is there nevertheless. When pointsmen are used there is always an element of danger arising from the possibility of duty being neglected, and when the work is left to the car-crews this danger is much intensified.

Inventors have striven throughout the ages to produce an apparatus that shall replace human fallibility by mechanical certainty, while it provides an allurement in the guise of economy to the people who have to be persuaded into using it.

The Exhibition brought forth two more of these machines, and we leave our expert readers to judge for themselves from our descriptions, first, whether either or both will fill the bill of requirements successfully; and secondly, which of the two it is going to pay better to install.

Turner's Automatic Point Controller was exhibited by Messrs. S. Dixon & Co. just as it would be supplied. Mr. Turner himself explained and worked the apparatus for all-comers, and the following description of the general outlines is taken from particulars supplied by the firm.

It is an electrical device for automatically moving both rail and overhead frog, and may be shortly described as follows:—Two switches are fitted on the overhead line—an actuating and reversing switch—the former being fixed about 45 ft. before reaching the point tongue, the latter being placed just beyond the frog, on the branch line. Upon the driver approaching the point and wishing to turn on to a branch line, he keeps his controller on the first notch when passing over the actuating switch, thereby opening the point. He then passes through the rail point and the overhead point, and his trolley head makes contact with the reversing switch, and automatically reverses the point, independently of the position of the controller handle, thus making it absolutely impossible for the point to be left open. There is no wiring, switches or fittings of any description on the car in connection with this device. This patent controller has passed its experimental stage, for it has been installed and is working successfully on the following tramway systems: — Leeds, Manchester, Bradford, Sheffield, Birkenhead, Cardiff, Gloucester, Brighton, Rotherham, Leicester, West Ham, Leith, New South Wales (Government), and others. There is a direct saving in pointsman's wages of 80 per cent., and the contrivance is absolutely self-contained and needs a minimum of attention.

The other controller is "Parr's" patent, and was exhibited by Messrs. Hadfield. They say: — This controller is operated electrically, and can be applied to any existing system of points. It works both the points and the overhead frogs at the same time, and does not call for any special equipment to the car or alteration of any description of the current collecting device or the wiring. It can be so arranged that the points unless operated are set for one line, or it can be so arranged that each car can move the points for itself. All that is required is for the motorman to have the ordinary motor controller on (any notch) to operate the points and off altogether if the points are not to be operated.

The first controller of this design was installed at one of the busiest junctions on the Leeds City Tramways, where the minimum service is 90 cars per hour, rising to 110 cars per hour at busy times. This severe test extending over a period of six months has shown that the controller is thoroughly efficient and reliable.

Fig. 96 is from a photograph of the complete mechanism. The whole machine is mounted on two strong standards S S, which carry an electro-motor M, capable of driving a train of gear wheels actuating the rail point through the hauling rod R, and link

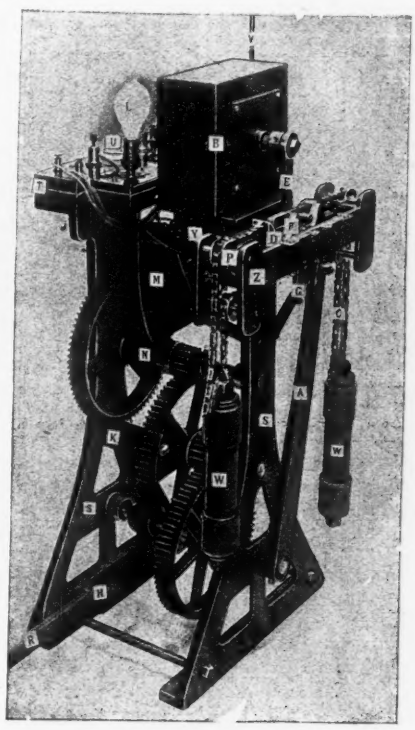


Fig. 96.—Parr's Patent Automatic Point Controller.

H, also the conductor point in either underground conduit or surface systems, whilst by a flexible or other suitable hauling rope V, it actuates the conductor point in overhead systems.

The direction of rotation of the motor M, and hence the position of the points, is controlled by a reversing switch (not seen) fixed to the front of the box B.

The switch spindle is actuated by the arm E, which in turn is actuated by a stout phosphor-bronze slider D, worked by one or other of two falling weights W W, which are attached to it by strong chains C.

The slider, which works on a guide bar, is caught and released by the plunger of a specially designed electro-magnet V, and the arm E, is controlled by a double-ended latch F, itself released by an arm G. The slider, its guide bar, the latch and pulleys P, over which the chains roll, are all carried by the stout frame Z. An arm A, actuated by the bottom shaft, raises the weights W, alternately, moving with the points from one side to the other. A highly insulating terminal board T, carrying the necessary terminals, fuse block U, and lamp or other resistance L, inter-connects the reversing switch, motor, electro-magnet, and source of supply.

The box B contains nothing but the necessary spring for controlling the arm E, while affording convenient bearings for the spindle of the switch.

The machine is contained in a neat cast-iron street box, specially designed to enable the whole machine to be got at in less than half a minute, and the controller can, if necessary, be actuated from the outside of the box, in case the driver passes the overhead contact with current off or on when it should have been otherwise, which is another great advantage.

A light contact is attached to the electrical conductor (whether overhead or underground), through the medium of which the auto-controller is operated. This contact is carried by the line itself, without having to cut it.

Messrs. Edgar Allen & Co., Ltd., exhibited a great variety of points, crossings and other special work, and particularly

interesting were the point silencers, of which there were three examples:—McKnight's, Radfords and Traver's.

Fig. 97 shows the first of these, which is very simple.

The "Iron-bound" point, of which they are the sole makers, has

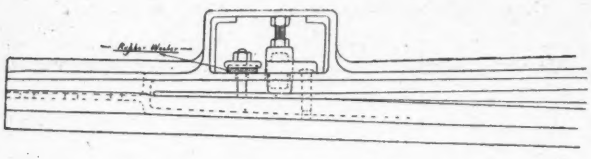

Fig. 97.—Plan of Allen's Patent Point Silencer.

many advantages, as it can be made to almost any length and is very easily fitted with fish-plates. It is illustrated in fig. 98 as applied to an open or "dummy" point, while fig. 99 shows its application as a movable point with the addition of a 3-way mechanism, which is shown more clearly in fig. 100. It is arranged

Fig. 98.—Plan of Allen's Iron-bound Point with Standard Rails.

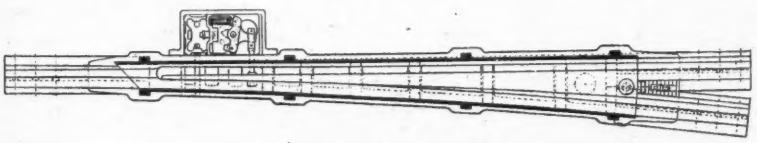

Fig. 99.—Plan of Allen's Iron-bound Point, fitted with 3-way Arrangement.

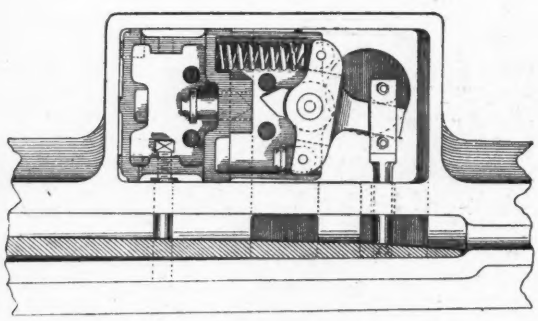

Fig. 100.—Enlarged View showing 3-way Mechanism.

for action as a 2-way point in both cases, but the addition of springs in the obvious positions adapts it for three-ways.

Millar's Karri and Jarrah, Ltd., and The Powell Wood-Process Syndicate, Ltd., represented the wood-paving business, while The "Grey-Royal" Granite Sett Co., Ltd., and Wm. Griffiths & Co., Ltd., did the same for stone setts.

The value of hard woods like Karri and Jarrah is shown by the small wear which has been noted on samples, taken for the purpose of measurement, from the streets of many English towns after being down from 3 to 11 years.

The preservation of timber by "Powellising" has been done for some time, and the results seem to be admirable. The process consists in thoroughly impregnating the wood fibre with sugar after driving off the occluded air. This is done by boiling the wood in a syrup until air bubbles cease to rise to the surface, and then subjecting the wood to baking at temperatures which vary according to the nature of the wood.

The temperature is increased gradually, a piece having 1 in. as the smallest dimension taking two hours, while a piece whose smallest dimension is 6 in. takes 12 hours to reach the maximum of 200° to 250° F. This maximum temperature is maintained for a length of time which varies also with the size of the piece, and is reduced in the same gradual way that it was raised.

Any kind of wood can be Powellised, and molasses, glucose or grape sugar, raw or refined beet or cane sugar can be used, the results with each having definite characteristics.

At the end of a report which is favourable to the Powell process, Prof. G. S. Boulger, F.L.S., F.G.S., &c., says:—"The increase of density alone which this process produces would seem to recommend it for naves, blocks, tool handles and many turners' purposes, the comparative non-inflammability of the processed wood would make it preferable to creosoted timber for building, and the increased density and durability combined, especially suggests its applicability to wood-paving, particularly to soft woods. It may claim to have raised some soft woods to the level of hard wood, and when Powellised, spruce and even Poplar may be used for paving. Thus Poplar may, when treated in this way, become what it has never been hitherto—a timber."

Fig. 101.—All-Wire Soldered Rail Bond.

The permanent way section closes with the mention of rail-bonds, as there were no rails to be seen, a fact on which we commented in the general review. Briefly, then, there were no novelties in bonds, but the Forest City Electric Co. and the British Electric Equipment Co. made an effort which should be successful to impress purchasers with the comparative flexibility and durability under the worst conditions of vibration of the ribbon type concealed, or sub-fish plate bond, while the latter company made much of the "All-wire "soldered bond, such as is illustrated in fig. 101. This bond has been used largely in the States, and the makers say that "in order to induce English engineers to drop their prejudice against the soldered bonds, they are willing to loan all their standard apparatus to customers who will use it." We dealt with the general aspects of rail-bonding in our issue of July 7th, with reference also to American practice.

As compared with their exhibit at the last Exhibition, the Forest City Co. had a greater number and variety of bonds and bonded joints on view this time, but they were only modifications of previous exhibits to suit the special conditions under which the bonds were to be used. The conductor-rail joint of the Hammersmith and City Railway was exhibited. We understand that these bonds will be fixed by a special hydraulic compressor, about which we may hear more later.

Messrs. R. W. Blackwell & Co. showed the bonds with which their catalogues have made us all familiar. They have made a slight alteration in the shape of their plugs, which permits the copper terminal to be expanded radially only, and not driven before the plug, as was the case sometimes when these were made quite parallel.

*(To be continued.)*

## NOTES ON MAINS WORK AND FAULT FINDING.—II.

By G. C. KNIGHT.

The calculations involved in the localisation of faults are usually very simple. To continue the consideration of Murray's loop test, the apparatus for which was described last week, the simple case, where the resistance of the leads is negligibly small, and bridge ratio is cable length ratio, cannot occur in practice. It is only this correction for leads that is ever supposed to be difficult, and this is really very easy, and can be made in a variety of ways.

If you know the resistance of your leads, the two being equal, and also of your cables, it is clear that

$$A = \frac{R}{k+1} - l,$$

where A = Resistance of shorter end of loop from testing point to fault,

R = Total resistance of loop = resistance of cable + 2 $l$,

$l$ = Resistance of one lead,

$k$ = Bridge ratio.

This formula I always used myself, until it was suggested to me that an ordinary mains foreman could not do so. I think this was a libel on the mains foreman, but devised a method to get over the difficulty. Let your bridge be divided into 98 parts. Make a pair of testing leads each equal in resistance to one division of your bridge, and let them be used as part of the bridge. You get then the simple ratio $p : q :: r : s$ without any correction whatever.

Another, and perhaps simpler method, is to make a pair of leads each of resistance exactly equal to (say) 100 yds. of ·1 sq. in. cable (3·4 yds. of No. 16), and tie to each a label marked "= 100 yds. of ·1, 60 yds. of ·06," and so on for all the sizes you use. The man who could not make the corrections for these is certainly unfitted to do your testing.

An earth may be found on a branching system which is unprovided with links as follows :—

Loop at any pair of ends and take a loop test which will show the apparent position of the fault at a joint. Loop any pair fed from that point and test again. If the fault is again apparently at a joint, loop a pair fed from *that* joint, and so on. When the test shows the fault not at a joint, or twice at the same joint with different ends looped, that is the place. This is a slower method than removing links but quicker than cutting.

Great accuracy may be attained on a three-wire system, because if the earth be, say, on the negative, you may loop positive and negative and locate, then loop neutral and negative and locate. The two tests should show the fault at the same place, and check one another.

To find an earth on a loop-main, by which I mean a distributor taken round a block with its ends joined together, has puzzled more than one. A cable would never now be so laid without a link box, but it has been done. To locate a fault on such a cable unless you have a number of

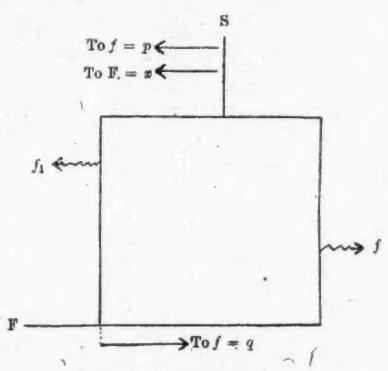


Fig. 2.—Earth on looped distributor

services is very difficult, but—theoretically at least—it is possible. I have never had to try it, but have devised the following test :—

Let the rectangle represent a loop-main, whose resistance if opened out would be R.

S the same pole of a service cable, resistance S.

F the connection from feeder, resistance F.

$x$ = that fraction of R between S and F, counterclockwise.

$1 - x$ = that fraction of R between S and F, clockwise.

All the above are known.

$f$ = the fault of resistance $f$.

$p$ = that fraction of R from S to $f$ counterclockwise.

$q$ = " " " F to $f$ "

All these are unknown. If we can get a formula to find $p$ we have the position of the fault.

Measure the resistance to absolute earth from S. Call this $R_1$. Measure the same from F. Call it $R_2$.

(*Note.*—It is essential that the test be to *absolute* earth. For all ordinary purposes a wire twisted on to a water pipe is good enough, but I have known this to show half an ohm to absolute earth, whereas ·01 ohm error will throw this test seriously out. To test resistance to absolute earth, proceed as follows :—Find two approximate earths, such as a water pipe and a bar driven into the ground; fix a wire firmly to each, long enough to reach your instrument; take a lead of known resistance to the cable under test. Call the unknown resistances in your artificial earths $E_1$ and $E_2$, and that through cable and fault to absolute earth, E. Now measure the resistance between cable and $E_1$, call it $r_1$; between cable and $E_2$ call it $r_2$; between $E_1$ and $E_2$ call it $r_3$.

Then $r_1 = E + E_1 \quad r_2 = E + E_2 \quad r_3 = E_1 + E_2$.

Hence $E = \dfrac{r_1 + r_2 - r_3}{2}$.)

Having obtained $R_1$ and $R_2$ by this method, it is obvious that $R_1 = S + (p\,R$ and $(1 - p)\,R$ in parallel$) + f$,

that is, $R_1 = S + p\,(R - p\,R) + f$.

Similarly $R_2 = F + q\,(R - q\,R) + f$.

Now if the fault be in $x$ as at $f_1$, then $q = 1 - x + p$.

If it be not in $x$, as at $f$, then $q = p - x$. A glance at the diagram will show this. Taking the latter case first we get—

$$R_1 - R_2 = S - F + p\,R - p^2\,R - (p - x)\,R + (p - x)^2 R$$

from which equation all unknowns are eliminated but $p$ which is required, and from which is deduced

$$p = \cdot 5 - \frac{R_1 + R_2 - S + F}{2\,x\,R} - \frac{x}{2}$$

In the other case we have—

$$R_1 - R_2 = S - F + p\,R - p^2\,R - (1 - x + p)\,R + (1 - x + p)^2 R$$

whence $$p = \frac{R_1 - R_2 - S + F}{2\,R\,(1 - x)} + \frac{x}{2}.$$

Here, of course, we have an ambiguity, the same test showing the fault in two places on opposite sides of the square. But you can dig up the cable at one point, and it is just an even chance if you find the fault; if not you go straight to the other. Even an ambiguous test is, in my opinion, better than blind groping in the dark, cutting and trying. Moreover, if you have a few more services on the loop you can take a fall of potential test which will at least show on which side the fault is, and then you have it exactly.

## Short Circuits.

We may now consider the localisation of shorts, by which I mean any unintentional connection between two conductors, whether of high or low resistance. The simplest case of all is where the two cables are fused or welded together, when a simple copper resistance test from one end gives the position of the fault. This test, though often recommended, is really useless in practice, as you cannot *know* that your cables are so welded, and if you *assume* this condition where it does not exist, you will be a long way out. Therefore we must assume that the fault has a resistance, small but unknown. It will always be small, as a short will never be detected until it takes enough current to call your attention to the fact that the current is not going out as ordinary consumption, and probably not until it begins to blow fuses.

There are several ways of localising a short. In the simplest case, a feeder, or plain run of cable, go and return, let P and N be the resistances of your two cables (on a two-wire

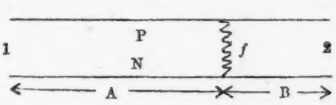


Fig. 3.—First short test

system they will be equal) $f$ = the resistance of the fault, A and B fractions of the resistance (or of length if the cables be of uniform section) from ends 1 and 2 respectively to fault (A + B = 1). Measure the resistances through the fault between ends 1 and 2. Call these $R_1$ and $R_2$.

Then $R_1 = A\,(P + N) + f \qquad R_2 = B\,(P + N) + f.$

Hence $$A = \cdot 5 + \frac{R_1 - R_2}{2\,(P + N)} \text{ and } f = \frac{R_1 + R_2 - P - N}{2}$$

This I think the best and simplest method of finding a short. The objections urged against it are the following: To get the actual resistance of the cables P and N, a correction for temperature has to be made. This, however, is not very difficult, as the temperature of deeply-laid cables varies very little, and the error for shallow cables will not be great if the temperature be assumed at that of the air. In short cables, indeed, the variation of resistance with temperature throughout the year is so slight as to be quite negligible. The extreme error in the result of the test due to this cause is about 1½ per cent. of the length of the cable, which is considerable on long runs, but not on short ones. Another and more serious objection is that the proper resistance of

the fault is assumed not to change between the two tests. If it varies much it will introduce a correspondingly large error. The following method obviates the last trouble. Connect, as in fig. 4, one end of wire bridge to one end of

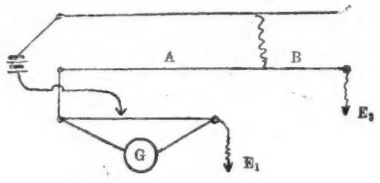


Fig. 4.—Second short test

cable: the other end of the bridge and also of the cable to earth: galvanometer across ends of bridge, and battery between bridge contact and the other cable. Then the bridge ratio at balance is the ratio of the two parts of the cable on either side of the fault.

If you can get a *really perfect* earth in both cases, no correction at all is required by this method: or if your cable be of high resistance compared with the resistances of your earths, the correction is negligible. But in the majority of cases your earth connections, with leads, will have a resistance distinctly significant, and therefore these resistances must be measured and taken into account.

Then the bridge ratio $= A : (B + E_1 + E_2)$, and here, of course, the correction for temperature must be applied where great accuracy is required—that is to say, on long cables. Thus this test is more difficult than the first, and is only to be recommended where the variation of the resistance of the fault is considerable as compared with the resistance of a yard of cable. Moreover, this test cannot be used, as can the first, in cases where you have an earth accompanying the short, as is so often the case. On a three-wire system shorts may be found with yet greater ease and accuracy. If all three poles be shorted together, use the first method applied to any pair. You can thus take three pairs, positive and negative, positive and neutral, neutral and negative, localise the fault on each, and the three results—which, obviously, should be alike—check one another and eliminate errors. The case is yet simpler where only two poles are shorted. Here a modification of the second test may be

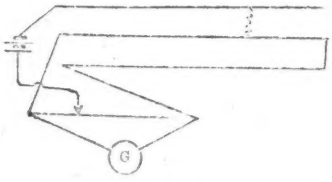


Fig. 5.—Short on one side of 3-wire system

applied with great advantage. Connect as in fig. 5, looping at the far end the sound cable to one of the damaged ones. Then at balance the bridge ratio is the ratio of the parts of the loop on either side of the fault.

It is not generally known that it is quite possible to localise pretty exactly a short on a branching circuit without cutting or disconnecting branches. Reference to fig. 6 will show that the branch cable with fault forms a short on the main cable at $f_1$. Testing by the first method, take resistances $R_1$ $R_2$ between ends 1 and 2 and locate to $f_1$ by the formula as given. Now here comes in the use of the formula $f_1 = \frac{R_1 + R_2 - P - N}{2}$, for this being the resistance of the short at $f_1$ is obviously the resistance you would get if you cut at the joint, and tested down the branch cable through the fault. Calculate this and call it $R_3$. Measure $R_4$ between the ends of branch, then, by substitution from the first formula, $C = \cdot 5 + \frac{R_3 - R_4}{2(P_1 + N_1)}$.

Similarly, if this test should show the fault at a joint to a sub-branch, the process may be repeated, the method being too obvious to need description. But practically I fear that unless your instruments are extremely accurate, you will not locate a fault correctly beyond the second sub-branch, as any errors will be likely to be cumulative.

On a modern system of mains, however, you are not likely to have a circuit branching to that extent without dis-

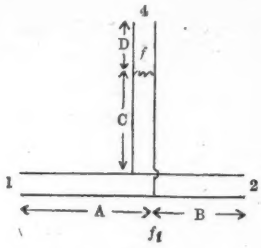


Fig. 6.—Short on branch

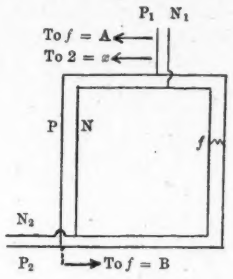


Fig. 7.—Short on looped main

connecting links. To find a short on a looped distributor:—

Let P and N be the resistances of the two cables of the loop; fig. 7.

$P_1$ $N_1$ ditto of connections to service.

$P_2$ $N_2$ „ „ feeder.

$x$ that fraction of the loop counterclockwise between 1 and 2. All these are known.

Let $f$ be the resistance of the fault: A the fraction of the loop counterclockwise from 1 to $f$, and B ditto from 2 to $f$. These are unknown.

Measure $R_1$ between ends 1 through fault and $R_2$ between ends 2.

Then $R_1 = P_1 + N_1 + (A - A^2)(P + N) + f$,

and $R_2 = P_2 + N_2 + (B - B^2)(P + N) + f$

$\therefore R_1 - R_2 = P_1 + N_1 - P_2 - N_2 + \{(A - A^2 - B + B^2)(P + N)\}$

Now if $f$ be in $x$ then $B = 1 - x + A$ if not $B = A - x$.

Substituting these values in the equation above, it reduces to:—

$$A = \frac{x}{2} + \frac{R_1 - R_2 - P_1 - N_1 + P_2 + N_2}{2(1 - x)(P + N)}$$

or

$$A = \frac{x}{2} - \frac{R_1 - R_2 - P_1 - N_1 + P_2 + N_2}{2x(P + N)}$$

Here again, as in the case of an earth on a similar circuit, we have an ambiguity, but the same remarks may be applied.

All the foregoing tests have been given on the assumption that you have got as near to your fault as possible by withdrawing links and making rough tests. In the description of the tests for earths and shorts on branching circuits, I have shown how a fault may be found on a small system without any disconnection. But where a system is much cross-connected, as all large systems are, these tests are of no use, and the preliminary business of localising to a section is often a lengthy and laborious matter. As an instance, I am assured by a friend who has charge of a large system, that a job of this sort recently took all his available staff over a week. Yet it is quite possible, on the largest and most complicated network to localise a fault from the station in a few hours, the supply not being interrupted for more than a few minutes, provided that the network is fed from at least three points. In theory you find the point exactly, but to do so requires extremely accurate instruments, a very exact knowledge of the resistances of all your cables, and of the position and value of your natural resultant fault, and a laborious and difficult calculation. In practice you may get within half a dozen streets of the fault, and then proceed removing links and testing around the spot so found.

Fig. 8 represents an imaginary network fed from the points, *a*, *b*, *c*, the station S and the feeders A, B, C, being shown outside the diagram for the sake of clearness. When an earth occurs make loop tests between A and B, A and C, B and C, using in each case, of course, that pole of the feeder which is earthed. Measure also the total resistance of the loop in each case.

Now, knowing the resistances of your feeders, you get the effective resistance of your network between feeding points.

From your loop test you have the proportionate distance of the fault down the loop, and hence its proportionate distance from either feeding point in that loop. But, obviously, there are many paths between *a* and *b*, *b* and *c*, *a* and *c*, so that in each case there are many possible positions for the fault. Let us suppose that the loop test has shown that the fault is half way from *a* to *b*. Take a few of the more obvious paths from *a* to *b*, calculate the point which is half way from either end, and join them by the line 1-2. The fault is somewhere in that line. The line 3-4 is got in the same

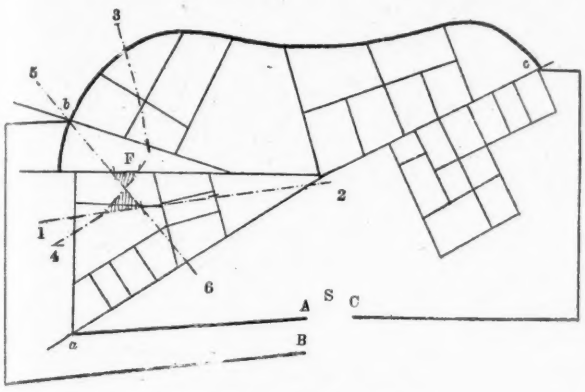


Fig. 8.—Fault on linked-up system

manner from the test between *b* and *c*, and the line 5-6 from the test between *a* and *c*. If all the points on each of these lines have been calculated with absolute accuracy, they will all cross at F, the exact position of the fault (or, rather, of the resultant of all faults on the system, a point which introduces the necessity to correct for your natural resultant fault). But if, as would actually be the case, the lines have been somewhat roughly calculated, their inter-crossing will include more or less space, and somewhere in or about that space is the fault, which may now be sought by the simpler methods. This space will be larger or smaller according to the accuracy with which the calculations have been made.

Finally, I would apologise to any engineer whose test has been published without acknowledgement. Some of these are matters of common knowledge, some I have learnt I know not where, the rest are my own, though they may have been independently thought out.

## THE LORAIN SYSTEM AT WOLVERHAMPTON.

Events have justified the bold and almost unaided attack which we made in 1902 on the policy of the Wolverhampton Corporation in laying their tramways on the surface-contact system. In those days Alderman Mander spoke airily of £20,000 profits, but the second year's working has produced a veritable mouse, £193, as stated in the abstract of the report for the year ending March 31st, published in our issue of July 14th. Fuller abstracts of that report, and of the ensuing discussion may be read in the Wolverhampton *Express and Star* of July 6th and 11th respectively. The speeches by the two aldermen who are the leaders of the defence, followed by the unanimous carrying of the report, prove well enough that the Wolverhampton Council are to be as easily caught with chaff now as in days of yore.

Alderman Mander, in moving the report, said that if the accounts had been made up in the standardised form the amount of £4,790 which was charged to renewals would have been carried into the net revenue account, and they would have had a net profit of £4,983 instead of £193. Oh, the righteousness of some people! But we must be unkind enough to explain that after crediting renewals with this £4,790 there is nothing but £193 left to pay off the outstanding deficit of £4,688 on electric and horse traction. *Therefore* the £193 is called net profit. That, at least, is how we read the state of affairs as represented in the *Express and Star*.

The bankruptcy laws ought to be altered after this. If a man cannot pay 20s. in the £, what he has to his credit he may keep for pocket money.

Now let us look at these figures with which Aldermen Mander and Craddock express so much satisfaction, and see what profit might have been made if the overhead system had been in use.

The report compares the Wolverhampton working with 39 other undertakings, and one result is to bring out the units per car-mile ·24 higher than the average. Alderman Mander says that this is accounted for "by the better lighting utilised on the Wolverhampton cars." Considering that one of the original reports of the borough electrical engineer stated that the use of the Lorain system involved an increased consumption of energy over that required by the overhead system of ·25 unit per car-mile, we think that Alderman Mander might have found refuge under cover of that estimate, and the only reason for his putting the increase down to lighting must be that he has developed under continued Lorain stress, a failing which is well known to mental experts.

It will be more amusing than instructive to work out roughly the simple problem which Mr. Mander has set—for others.

According to the Electrical Review Table of Tramway Undertakings, recently published, Wolverhampton owns 32 cars. The report says that 809,500 car-miles were run. Dividing car-miles by cars owned gives 25,000 car-miles per car per annum. To find the hours run by each car, let us assume the very low average speed of 5 m.p.h. in order to allow fully for lighted cars standing in sheds, and for other sources of waste; that gives 5,000 hours per car per annum. Let us assume again that for a quarter of this time, manifestly much too great a ratio, the cars were lighted; 1,250 then are the hours of lighting per car.

Now, 809,500 × ·24 = units used in excess of average = 194,000, and 194,000 ÷ 32 = 6,000 excess units per car per annum. This enables us to reach an approximation of the extra units per car *used for lighting* over and above the ordinary use in 39 other towns:—

$$6{,}000 \div 1{,}250 = 4{\cdot}8 \text{ units per hour.}$$

If one 16-c.p. lamp takes 64 watts, 4,800 watts for one hour (4·8 units) = 75 16-c.p. lamps.

Of course, if Alderman Mander suggests to the Tramways Department the use of higher efficiency lamps—say, flame arcs—the Wolverhampton cars might be illuminated still better than the poor average concern which never affords more than 20 16-c.p. lamps per car at the very outside.

If we take these 194,000 excess units as an ordinary man would, and call them part of the blood money of the Lorain system, we can see just how much might have been written off the accumulated deficit if the overhead system had been installed when we multiply by 1·66 and divide by 240. The result roughly is £1,340. That begins to make the actual declared profit of £193 look small, but we have an inkling that even this comfortless kind of sop to the ratepayers would have been reduced by £1,350 if the price of energy charged by the Lighting Department to the Tramway Department had been the same as last year. We do not say for a moment that it is too high at the present rate of 1·66d., but we wish it to be understood that last year's rate was 1·91d. (*Electrical Times*).

The comparative figures to which we have referred show that the Wolverhampton passengers have to pay more than the average passenger for the privilege of riding over Lorain track. The precise amount appears to be ·03d.—evidently of no account in the eyes of financial experts of the calibre of Alderman Mander, for he distinctly said in his speech that, "with the single exception of units per car-mile, Wolverhampton had a better average than any town."

The three-hundredth part of a penny sounds too infinitesimal to trouble about when referred to as the extra amount which a passenger has to hand over to the conductor for an average journey, but when multiplied by 7½ millions, it increases in importance sufficiently to be taken cognisance of even by people who talk about £20,000 profits, and get £200. When multiplied in fact by the number of passengers carried in 1904-5, it just means that the balance-sheet has gained £960.

There are figures in the balance-sheet which we cannot criticise, as we are without the means, but those figures which we have touched somewhat transform the published results. Recapitulating, we have £1,340, which is directly traced to the Lorain system, and £960 which has been extorted from the passengers, making £2,300 which would have been applied to the reduction of accumulated deficit if the overhead system had been used.

On the other hand, we noted that this year's balance-sheet cannot be compared justly with last year's, unless due allowance, which we have put at £1,350, is made for the reduced cost of electricity in 1904-5.

With reference to the negotiations between the Wolverhampton Corporation and the company which runs trolley lines up to three points on the Wolverhampton boundary, we plead guilty to a spirit of curiosity in wishing that the terms of the proposed agreement between the parties might have been disclosed in more detail. Prominence is given to the statement that the cost of equipping the Corporation cars with trolleys to enable them to run on the effete and vulgar overhead system will be about £200—say, £6 per car; but what about the cost of equipping the company's trolley cars with skates and all the paraphernalia that adds a ton or more to the weight of the car? If the company does not pay for this, what is it going to cost the Corporation? And if the company does pay the actual bill for alterations, how much worse will be the Corporation's bargain for through running to make up to the company for the £100 or £200 per car for Lorain equipment and alterations made necessary thereby, for the 20 per cent. increased consumption of energy due to the Lorain solenoids, for the upkeep of the accumulators and for the maintenance of the collecting skates? Somebody has to pay for these things, and even in the remote chance of the company being so eager to obtain the benefits of through running as to bear the whole of the direct and incidental costs of conversion the general question still remains, why should anyone, whether shareholders or ratepayers, have to pay extravagantly and so absolutely unnecessarily if right counsels had prevailed in the first place, for being transported from one place to another over an imaginary line without changing cars?

Unless the ratepayers of Wolverhampton are as deathly sick of their Tramway Committee as the nation is of the War Office, and so has no more heart to urge reforms, we suggest that the proposed agreement be compared with similar agreements for intercommunication which have been exchanged between town and town or town and company elsewhere, with the object of finding out how much better or how much worse a bargain than those the Committee intends to make.

## THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

### An Improvement Reported to be Proceeding all Round.

If prices do not prevail so high as in the years 1899 and 1900, the volume of orders on the books of the large companies in Germany at the present time is considerably greater than in those years, and it is believed that the electrical industry is once more on the way to a high period of prosperity, even if it has not already reached such a stage. No doubt the improvement in the general situation has been largely brought about by the amalgamations of works and the starting of the manufacture of turbines during the past year or two, while the extension of existing electricity works and the renewals of tramway plant and equipment are providing a fair amount of activity, in addition to the demands made by the mines and ironworks. The internal disturbances in Russia, which have resulted in the destruction of electrical machinery, have so far reacted favourably upon the German works, but the future outlook from that quarter is regarded with uncertainty. The question of working main lines of railway by electric traction also remains in an indefinite position at the present time.

The subject of probable dividends on the part of various concerns is receiving a little attention. It is calculated that the rate of the Allgemeine Co. will be slightly higher than that paid in the past year, that the Siemens & Halske Co. may pay 8 per cent., as compared with 7 per cent., that a cable manufacturing company will declare 5 per cent., as against 3 per cent., and that the Schuckert Co., whose last distribution was made in 1900, may return to the dividend stage with 4 per cent. for the past year.

### German Works.

The shareholders in the Lahmeyer Co. (Elektricitäts A.G. vorm. W. Lahmeyer & Co.), of Frankfort-on-Maine, have approved the accounts for the year ended March 31st, 1905. As will be remembered, the company's manufacturing works have recently been amalgamated with the cable works of the Felten & Guilleaume Co. under the title of the Felten & Guilleaume-Lahmeyer Works Co., and the year 1904-5 therefore constitutes the last in which the Lahmeyer accounts will refer both to the construction of generators and motors, and to the company's own lighting stations and tramways as a separate and independent undertaking. The position of the company is in brief as follows:—

| | 1904-5. | 1903-4. |
|---|---|---|
| Share capital ... ... | £1,000,000 | £1,000,000 |
| Net profits ... ... | £63,629 | £30,831 |
| Dividend, per cent. ... | 5 | 2½ |

The gross profits from manufacturing and other sources are all placed together in the accounts as one total. In addition to the share capital of £1,000,000, the company has a tolerably large issue of bonds, the payment of interest on which has absorbed over £31,000, as compared with £29,000 in 1903-4. The directors' report states that notwithstanding the considerable amount of work carried out, the prices realised on the average remained on the unfavourable level prevailing in the preceding year, but a satisfactory development of business is expected in the future. The Mulheim department of the amalgamated company is fully employed with larger orders, and it is anticipated that favourable results will be obtained from the operations of the combined undertaking this year. The Lahmeyer Co.'s own stations and tramways are said to have yielded in part an increased revenue in the past year.

The report of the directors of Brown, Boveri & Co., of Mannheim, whose share capital is entirely held by the parent company of the same name at Baden, states that the improvement in the course of business recorded a year ago continued in the past year, and became even more satisfactory. It was necessary, in consequence of the large amount of work, to keep regular day and night shifts during the whole of the year, the number of workmen increasing from 598 to 1,172. The considerable augmentation in the turnover rendered it essential to largely extend the works, particularly in the electrical department, and in connection with this extension the remainder (£150,000) of the share capital was called up at the end of last March, thus making the paid-up share capital £300,000, although only one-half of this total participates in the distribution for the past year. The financial results are shown below for the past two years:—

| | 1904-5. | 1903-4. |
|---|---|---|
| Share capital ... ... | £150,000 | £150,000 |
| Net profits ... ... ... | £9,480 | £7,486 |
| Dividend, per cent. ... ... | 5 | 4 |

The accounts show that the sum of £18,417 has been written off for depreciation, as compared with £11,076 in 1903-4, the percentages provided for this purpose being 5 per cent. on buildings, 10 per cent. on machinery, 25 per cent. on furniture, and 40 per cent. on tools. In addition to carrying out various light and power works during the year, the company received orders for 63 steam turbines of a total of 89,607 H.P. for Germany, as against 69 and 50,535 H.P. respectively in the year 1903-4. The small cruiser, *Lubeck*, fitted with turbines of 12,000 H.P., has completed its preliminary trials with success, and the company expects further orders from the Admiralty. The works are also well employed in the construction of condensing plant.

### Swiss and Other Companies.

The directors of the Bank for Electrical Enterprises (Bank fur Elektrische Unternehmungen), of Zurich, which is closely associated with the Berlin Allgemeine Co., have issued their report for 1904-5, in which, as on former occasions, reference is made to the general situation of the electrical industry. It is pointed out that the improvement reported a year ago has been maintained, as brisk activity is announced from all districts, but with the exception, perhaps of the construction of large sizes of turbo-generators, the sale prices are still unsatisfactory. The favourable judgement of the public and the Stock Exchanges in electrical securities has made further progress, although in many cases the directors consider that an exaggerated value has been placed upon the present course of business and the prospective results in the next few years. The improvement of business has been undoubtedly assisted by the combination of German and Swiss electrical companies in groups and by association with others, partly outside of Europe, and these arrangements would certainly further contribute towards progress. As to the future, the report states that this may be looked forward to with confidence, and that it will be possible to succeed in solving the problem of working main lines of railway by electricity. The financial situation of the bank may be briefly noted as follows:—

| | 1904-5. | 1903-4. |
|---|---|---|
| Share capital ... ... | £1,440,000 | £1,320,000 |
| Bonds ... ... ... | £1,320,000 | £1,280,000 |
| Gross profits ... ... | £201,769 | £176,392 |
| Net profits ... ... | £129,851 | £113,331 |
| Dividend, per cent. ... | 8½ | 7½ |

A glance at the bank's lengthy list of investments shows that these refer to tramways and electric light and power undertakings in different parts of the world, including the Seville Tramways Co. and the Chilian Electric Tramways and Light Co.

The financial results of Brown, Boveri & Co., of Baden, Switzerland, again show a further development. In the report for 1904-5

the directors state that the construction of large steam turbines and accessory electrical generators represented about one-half of the turnover. The steam turbines ordered to the beginning of July were 324 of a total of 397,000 H.P., as compared with 225,000 H.P. on the books at the corresponding period of the preceding year. Complaints are made of the condition of prices, which, in the case of medium and small size sets of machines, were insufficient, and even partly resulting in a loss. In the ordinary electrical department the company was also actively employed, but the prices remained unsatisfactory, and no prospect exists of a noteworthy improvement. The principal business in Switzerland continued to lie in deliveries for large power stations, although a considerable falling off would have to be reckoned with on account of the difficulties which have arisen in connection with the concession conditions for the establishment of new works. In the case of electric railways, the orders given for Switzerland in particular were very insignificant. The accounts reveal the undernoted position:—

| | 1904-5. | 1903-4. |
|---|---|---|
| Share capital ... ... ... | £640,000 | £500,000 |
| Bonds ... ... ... ... | £200,000 | £200,000 |
| Net profits ... ... ... ... | £61,083 | £54,225 |
| Dividend, per cent. ... ... ... | 10 | 9 |

In 1902-3 the dividend was at the rate of 7 per cent., and 5 per cent. was paid in the year immediately preceding, while the amount of the capital increase which has recently been proceeded with is not entitled to participate in the dividend for the past year. The report, which also refers to the operations of the subsidiary companies at Mannheim, Milan and Christiania, and to others in which the company is also financially interested, states that the Swiss workshops are fully employed, and likely to yield favourable financial results likewise for the current year.

The French Société d'Electro-Métallurgie of Dives, which has a share capital of £600,000, produced 8,000 tons of copper during 1904 as compared with 7,400 tons in the preceding year. As net profits the accounts show the sum of £26,265 as contrasted with £20,900 in 1903; and of the former the amount of £15,000 has been placed to the reserve fund for fluctuations in the price of the metal, thus increasing this fund to £48,000. The payment of a dividend, as in the previous 12 months, is consequently not contemplated. The stocks of raw and manufactured copper represented about 4,000 tons at the close of the financial year.

The Russian Allgemeine Electricity Co. has decided to pay a dividend for the first time in its history. According to the accounts for 1904, the net profits including the balance brought forward from the previous year amount to £4,945, as compared with £1,075 in 1903. It is proposed to distribute 4½ per cent., which dividend will require £4,500. The directors' report states that by virtue of the extraordinary general meeting held last December, it was resolved to absorb the undertaking of the Russian Union Electricity Co., and for this purpose to increase the share capital to £600,000, and issue an obligation loan of £200,000. The Riga works of the Union Co. have already been taken over, and are producing independently, a fact which the directors consider of great importance in view of the increase in the import duties provided for under the new tariff treaty between Russia and Germany.

The Russian Baltic Accumulator Works Co., of Riga, has terminated the year 1904 with a loss of £5,587, thus increasing the total deficiency to £22,020 on a share capital of £33,000. In view of the unsatisfactory financial position, the shareholders have decided upon the liquidation of the company. The factory, which was established by the founders of the Russian Union Co., is to be transferred to the Russian Allgemeine Electricity Co., which has also taken over the undertaking of the Union Co.

## THE ARRANGEMENT OF STEAM PIPES.

In a recent issue of the *American Electrician*, Mr. R. T. Strohm gives a review of present practice in steam piping, with more especial reference to the effects of expansion and the means taken to allow for it in the erection of the piping system. As is well known, expansion takes place in proportion to the length of pipe heated, its rise in temperature and to a "coefficient of expansion," which is a constant for a particular material. *E.g.*,

| | |
|---|---|
| Cast-iron ... ... ... ... | ·00000617 |
| Wrought-iron ... ... ... ... | ·00000686 |
| Steel ... ... ... ... ... | ·00000599 |

All expansion is accompanied by a tremendous stress in the material, which becomes apparent if any rigid anchoring is attempted. Something has to "go." To illustrate this:—A steel chimney, led through an office building of some 20 storeys, by some means became anchored to some steel girders near the top. The longitudinal expansion exerted sufficient force to shear off the rivets in a girth seam, and the chimney simply telescoped. The force exerted is estimated by calculation at 1 million lb.

In his review of expansion bends, the author mentions the common "gooseneck" bend and its modifications, including a combination of two elbows and an inverted U, which latter he objects to on the score of the strain on the joints and consequent lack of steam tightness. For situations where it is not essential that the whole range be in one straight line, he advocates a single turn of the pipe—placed vertically or horizontally as may be convenient—which results in the displacement of the pipe line by a little more than its diameter. Or for similar cases, where the stress is not great, a section of straight pipe, with the ends bent to bring the flanges parallel and to fit the ends of the range, can be used with advantage.

All expansion bends should preferably lie with their axes in the same slope as the pipe line, but if space is not available they may be set vertically, in which case efficient traps must be fitted to them to carry off all condensed steam. In all cases special care must be taken to guard against the introduction of water pockets, and the whole range should have a downward slope in the direction of flow of the steam, except where the velocity of the steam is low, as in a pipe made large for its duty.

For expansion joints, a simple section of corrugated copper pipe is capable of taking up considerable expansion. If thought desirable, such a section may be put under stress when cold. This will have the effect of diminishing the maximum stresses, as the pipe will be under compression when hot. (This practice is open to criticism, as a copper pipe subject to alternate stresses, especially under high temperature, may in course of time become brittle owing to "crystallisation" of the metal.)

A class of expansion joint that relies on a slipping action to take care of expansion is not so much used as formerly. It consists of two pipes of different sizes, arranged to telescope the one within the other, with a suitable packed joint between them. Such a joint has a tendency to part, due to the unbalanced steam pressure equal to the product of the area of the larger pipe at the joint into the steam pressure per unit of area. In order to prevent the disastrous effect of parting these pipes under pressure, a collar is rivetted round the smaller pipe beyond the joint, and the stud bolts holding the gland are extended to pass through this. Locknuts are placed on the ends of these studs, so that they just clear the safety collar when the range is cold. The disadvantages of such a joint include its cost compared to a simple bend, leakage owing to hardening of the packing, and the possibility of the pipes sticking fast, with resultant fracture. They should only be used in cases where other forms are inadmissible.

Pipe lines are supported by simple hangers from girders running above, or supported on rollers carried on wall brackets. The rollers are made to fit the curvature of the pipe. With long ranges it is usual to anchor the pipes near the centre, making provision for expansion as needed at either end. As regards the supporting of pipe lines, the hanging support would seem to give greater facilities for covering and inspection.

## RECENT IMPROVEMENTS IN THE ELECTRO-DEPOSITION OF METALS.

An article upon this and kindred subjects has recently appeared in the *Chemiker-Zeitung* from the pen of Dr. H. Stockmeier, and from parts of it we abstract the following particulars.

*Electro-deposition of Zinc.*—Amongst recent improvements in this direction it may be mentioned that Meurant, of Arlon, in Belgium, claims to obtain a specially compact and firmly adherent coating of zinc, by the addition of gum Arabic to the electrolytic bath. He mixes 5 kilos of a 50 per cent. solution of zinc chloride with the solution of 1·5 kilos of sodium carbonate in 10 litres of water. Three kilos of ammonium chloride are also dissolved in 20 litres of water, the liquid is heated, and 6 kilos of gum Arabic are dissolved in it. These two liquids are mixed together, heated for a short time, and finally diluted to 100 litres with water. Goldberg, of Moscow, claims to obtain thoroughly adherent films of zinc by the use of pyridine. He prepares his bath by dissolving 10 grms. of zinc chloride in one litre of water, introducing 10 c.c. of pyridine, and then adding hydrochloric acid till solution is complete. He employs zinc anodes, and a current density of 0·2 ampere per square decimetre. Goldberg also claims on behalf of his process that the bath is not too poisonous for industrial purposes like those composed of cyanides; but, as Stockmeier observes, the toxicity of cyanide baths does not prevent them being employed on the large scale where required, while, on the other hand, cyanide baths are never used in the case of zinc.

The Siemens-Schuckert works, of Berlin, has patented a method of procedure whereby hoop or band iron can be continuously coated with an electro-deposit of zinc, as is already done in the case of iron wire and other kinds of metallic strip. The feature of the invention consists in causing the iron, before entering the electrolytic cell, to pass between sets of leather-covered rollers revolving in a direction opposite to that in which the strip is travelling; the rollers being fed with sand or other suitable abrasive, and being so arranged that they clean both sides of the strip simultaneously. It is said that this contrary motion of the rollers ensures such a perfect scouring of the metal, that the electro-deposited film of zinc is satisfactorily adherent to both sides.

M. P. Lloyd, of Brussels, has adopted the plan of using diaphragms treated with insoluble albumin or gelatin, such as are sometimes employed in the electrolysis of alkali chlorides, in the electro-deposition of metals. It is very essential that the substance applied to the diaphragm shall be rendered perfectly insoluble, and therefore, after the use of the gelatin or glue, the diaphragm should be treated with formaldehyde for several hours. When properly prepared, the treated diaphragms yield metallic deposits of excellent strength and other physical properties. For instance, a foil of copper may be obtained which will bear rolling out to ten times its original length, a degree of extension which has hitherto been impossible. The improved diaphragms also cause the current efficiency of the process to be much greater than usual. With an

iron anode the weight of copper deposited has reached 93·5 per cent. of the amount theoretically corresponding with the quantity of iron dissolved, whereas when the ordinary process was employed the yield was only 39·1 per cent. If the electrolytic solution is treated with an albuminous substance, the current efficiency of the deposition may reach 84·9 per cent., but the metal thrown down is brittle, and cannot be worked up until after it has been melted. When one of the prepared diaphragms is employed, albumin or gelatin is not to be detected in the solution.

*Nickel.*—In order to obtain a deposit of nickel adhering well to iron or steel, Edison proposes to coat these metals with the nickel electrolytically, and then to heat the object in an indifferent atmosphere to the melting point of nickel. The molten film is said to adhere so well that it will not crack when extended or stamped.

To prepare non-conducting articles to receive a deposit, F. Hundhausen coats them with varnish, and, while the film is still tacky, dusts them over with silver powder. When completely dry the excess of metal can be blown or dusted away. The objects are then dipped in a copper solution, without using current, till a thin deposit is obtained, and finally the usual electrolytic operation is carried out.

For tarsiatura work, where it is desired to have metallic inlays on a non-metallic surface, E. Hugendubel, of Stuttgart, cuts out of the veneer, the wood which corresponds to that portion of the pattern that is ultimately to be represented by metallic inlay, and fastens it down on to a sheet of metal provided with teeth for holding purposes. The back of the sheet is protected with varnish, and the whole is plunged into the electro-depositing bath. A deposit is thus obtained on the bare metal which eventually becomes flush with the surface of the surrounding veneer in the necessary manner.

## NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

13,964a. "Improvements in and connected with electric lighting or other installations." P. F. Corkhill. (Date applied for under Rule 5 of the Patents Rules, 1905, July 6th, 1905.) August 17th. (Complete.)

16,457. "An improved bayonet socket-holder for incandescent electric lamps." J. Cleary. August 14th.

16,460. "An automatic starter for electric-motors." J. Jessen. August 14th. (Complete.)

16,471. "Improvements in lamps for Nernst filaments." L. Kamm. August 14th.

16,479. "Improvements in and relating to telephone systems." J. W. Lattig and C. L. Goodrum. August 14th. (Complete.)

16,484. "Improvements in call signal apparatus for group-calling in telephone installations." Siemens Bros. & Co., Ltd. (Siemens & Halske, Akt-Ges., Germany.) August 14th. (Complete.)

16,491. "Coiling apparatus for hollow or solid flexible conductors for gas, electricity and the like with auxiliary support for the hollow conductors." S. Quincey and C. Harrison. August 14th.

16,518. "Improvements in dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) August 14th. (Complete.)

16,545. "Improvements in or relating to electric arc lamps." A. D. Jones and The Jandus Arc Lamp and Electric Co., Ltd. August 15th.

16,546. "Improvements in or relating to electric arc lamps." A. D. Jones and The Jandus Arc Lamp and Electric Co., Ltd. August 15th.

16,547. "Improvements in or relating to electric arc lamps." B. M. Drake, A. D. Jones and The Jandus Arc Lamp and Electric Co., Ltd. August 15th.

16,570. "Improvements in storage batteries." G. K. Hartung. August 15th. (Complete.)

16,571. "An improved attachment device for the shades of inverted incandescent gas and electric fittings." Entwistle & Stephens, Ltd. August 15th.

16,631. "Improvements in the manufacture of electrical resistances." C. Ruzicka. August 16th.

16,655. "Improvements in or relating to wireless telegraphy." G. Marconi and Marconi's Wireless Telegraph Co., Ltd. August 16th.

16,656. "Improvements in tremblers for electric sparking apparatus." Marconi's Wireless Telegraph Co., Ltd., and E. Priddle. August 16th.

16,657. "Improvements in and relating to electric arc lamps." The British Thomson-Houston Co., Ltd., and E. J. Murphy. August 16th.

16,671. "Electric working of mine shafts." J. Swinburne. August 17th.

16,724. "Improvements relating to electrical apparatus for controlling the working of ordnance." A. T. Dawson and J. Horne. August 17th.

16,772. "Improvements in and relating to connection boxes for electric cranes." Siemens Bros. & Co., Ltd., and J. S. Huddleston. August 18th. (Complete.)

16,773. "Improvements in revolving field magnets for electrical machines." Siemens Bros. & Co., Ltd. (Siemens Schuckertwerke G.m.b.H. Germany.) August 18th. (Complete.)

16,796. "Improvements in devices for the electrographical long-distance transmission and reception of drawings, photographs and the like." H. Carbonnelle. August 18th. (Complete.)

## PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

### 1904.

Dynamo-Electric Machines. Sayers and Mavor & Coulson, Ltd. 15,626.

Arc Lamps. Viarmé. 15,872. July 16th.

Electric Motor Control Systems. British Thomson-Houston Co., Ltd. (General Electric Co., Ltd.) 16,662. July 28th.

Electric Switches. Johnson. (Voigt & Haeffner, Akt.-Ges.) 16,764. July 29th.

Electric Vapour Arc Lamps. Peritz. 17,176. August 5th.

Trolley Pulleys for Electric Railways, Tramways and the Like. Welch. 17,207. August 6th.

Terminal for Electric Cables. Sardy. 17,375. August 9th.

Filaments for Electric Incandescent Lamps and Methods of Manufacturing the Same. Levis. (General Electric Co.) 6,929. March 25nd.

Production of Electro-Tiles or the like. Sherard Cowper-Coles & Co., Ltd., and Cowper-Coles. 15,762. July 15th.

Electric Measuring Instruments. British Thomson-Houston Co., Ltd. (General Electric Co.) 16,410. July 25th.

Electric Ignition Apparatus for Exploding Gases in Rotary or Reciprocating Engines. Somerville. 16,619. July 28th.

Stopping Place Indicators for Electric Tramcars and the like. Wright. 16,853. August 2nd.

Electro-Magnetic Relays. Tyer, Hollins and Leake. 17,000. August 3rd.

Electric Motor Control Systems. British Thomson-Houston Co., Ltd. (General Electric Co.) 17,017. August 3rd.

Controllers for Electric Motors. British Thomson-Houston Co., Ltd. (General Electric Co.) 17,021. August 3rd.

Electric Switches. British Thomson-Houston Co., Ltd. (General Electric Co.) 17,023. August 3rd.

Electric Controllers for Electric Circuits. British Thomson-Houston Co. Ltd. (General Electric Co.) 17,024. August 3rd.

Means for Operating the Points of Electric Tramways and the like, and also the Overhead Points or Trolley Switches and Devices for Actuating Such-Operating Means. Norris. 17,632. August 13th.

Electrical Measuring Instruments. Evershed & Vignoles, Ltd., and Evershed. 17,808. August 16th.

Electric Device for Indicating the Unauthorized Opening of Door Locks, Window Fasteners, and the like. Levin. 18,054. August 20th.

Mercury and the like Vapour Electric Apparatus. Carolan. (General Electric Co.) 18,173. August 22nd.

Instruments for Making Calculations in Regard to Electric Conductors and Other Problems. Hincks. 19,061. September 3rd.

Push Buttons and the like for Electric Bells and Similar Services Harcourt. 19,917. September 15th.

Electrical Resistances. Moy and Bastie. 22,647. October 20th.

Insulators for High Voltage Electric Lines. Soc. Ceramica Richard-Ginori. (Date applied for under International Convention, June 22nd, 1904.) 28,804. December 29th.

### 1905.

Vapour Electric Apparatus. Wood. 956. (Date applied for under International Convention, January 18th, 1904.) January 17th.

Electric Apparatus for Felling Trees or Sawing Wood. Wilson. 1,484. (Date applied for under International Convention, January 20th, 1904.) January 24th.

Binding Screws and Terminals for Electric Conductors. Maunsell, Butt and H. W. Cox, Ltd. 1,518. January 25th.

Temperature Compensating Devices for Thermo-electric Temperature Measuring Instruments. Bristol. 2,934. February 13th.

Field Magnet Arrangements of Alternate Current Electrical Machines. Elektrizitäts Act.-Ges. vorm. W. Lahmeyer & Co. 4,859. (Date applied for under International Convention, April 30th, 1904.) March 8th.

Windings of Field Magnets of Dynamo-electric Machines. Siemens Bros. and Co., Ltd. (Siemens-Schuckertwerke G.m.b.H.) 5,834. March 20th.

Vapour Electric Apparatus. Thomas. 10,653. May 22nd.

Apparatus for Starting and for Regulating the Speed of Compensated Single-Phase Electric Motors. Arnold and La Cour. 10,830. May 24th.

Alternating Current Measuring Instruments. Conrad and Bradshaw. 11,036. May 26th.

Method of Controlling the Feeding Mechanism of Electric Arc Lamps of the Open and Enclosed Types. Fry. 618. January 12th.

Incandescent Electric Light Bulbs. Burt. 1,065. January 19th.

Electric Railway System. Kinsman. 1,912. January 31st.

Electric Ignition Arrangements for Explosion Motors. Sheller. 2,628. February 9th.

Telephone Transmitters. Bines. 4,168. February 28th.

Contact Devices for Electric Switches. Elektrizitäts Act.-Ges vorm. W. Lahmeyer & Co. 7,405. (Date applied for under International Convention, May 9th, 1904.) April 7th.

Apparatus for Electrical Drying of Insulation of Electric Cables. Nisbett. 8,613. April 22nd.

Manufacture of Copper Sulphide for Thermo-Electric Couples. Cie. Thermo-Electrique (Systeme Hermite) Soc. Anon. 11,300. (Date applied for under International Convention, April 27th, 1905.) May 30th.

Electric Transformers. Heinicke. 700. January 13th.

Electric Train Lighting Systems. Union Elektricitäts-Ges. 1,589. (Date applied for under International Convention, January 27th, 1904.) January 26th.

Safety Lock with an Electric Warning Device and Detonator. Audibert. 2,187. February 3rd.

Electric Furnaces. Bosworth. 2,313. February 6th.

Telephone Exchanges. Lundquist. 4,716. March 7th.

Distribution of Electric Energy to Apparatus Capable of Being Operated by Direct and Also by Alternating Currents. Lamme. 8,711. (Date applied for under International Convention, May 3rd, 1904.) April 25th.

Electrical Hydro-Pneumatic Governor for Marine Engines. Grasset. 419. January 9th.

Electric Fans. Fairweather. (Diehl Manufacturing Co.) 1,552. January 26th.

Alarm Fuse for Telephone Exchanges. Craft. (Date applied for under International Convention, February 5th, 1904.) 1,607. January 26th.

Electrical Trolley Heads with Wire Finding Apparatus Attached. Cherry and Clive. 2,888. February 13th.

Electric Current Circuit Breakers. Moy and Bastie. 5,232. March 13th.

Electric Clocks. Hope-Jones. 6,066. March 22nd.

Electric Clocks. Campiche. 7,211. April 15th.

Method of Securing the Removable Cover of a Tumbler or like Electrical Switch. Davies. 7,438. April 8th.

Electric Induction Meters. Cie. Anon. Continentale pour la Fabrication des Compteurs a Gaz et Autres Appareils. (Date applied for under International Convention, February 16th, 1905.) 8,540. April 20th.

Vapour Electric Apparatus. Thomas. (Date applied for under International Convention, May 25th, 1904.) 10,653. May 22nd.

Receivers for Wireless Telegraphy. Thompson. (Ges. für drahtlose Telegraphie m.b.H.) 10,708. May 22nd.

Current Controller for Electric Railways on a Sectional Conductor System. Duckworth, Duckworth & Kerr. 689. January 13th.

Apparatus for Use in Wireless Telegraphy. Heinicke. (Date applied for under Patents Rule 9, January 13th, 1905.) 700a.

Electric Motors. Latour. (Date applied for under International Convention, January 18th, 1904.) 952. January 17th.

Electrical Sound Producing Apparatus. Legendre. (Date applied for under International Convention, September 24th, 1904.) 3,283. February 16th.

Transmission of Electrical Energy Through Space for the Purpose of Wireless Telegraphy and the like. Arbon. 3,594. February 21st.

Electric Trolley Heads. Hensley. (Date applied for under International Convention, May 5th, 1904.) 3,885. February 24th.